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A COMPUTERIZED FARM COST ACCOUNTING SYSTEM

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CHAPTER I

INTRODUCTION

It is not known exactly when the first accounting systems entered the history of man. One can hypothesize that a number of factors, such as the use of money and basic writing techniques, contributed to their development.

The early accounting systems, which were doubtlessly crude, have been modified and improved through time and, in the last half-century, more advanced and complex cost accounting techniques have come into common usage. The purpose of these systems is to determine detailed costings and returns of activities or enterprises.

The costs related to the activities or enterprises can be external business purchases and intra-business costs. Because few activities or enterprises have only direct expenditures, most also draw upon services or inputs from other parts of the business. Therefore, in costing an activity or enterprise both types of expenses should be considered. The factor differentiating cost accounting from other accounting systems is its consideration of intra-business transactions where the income for one account is an expense to another.

Importance and Limitations of Farm Cost Accounts

Farm cost accounting records have been a valuable source of data for aiding management in decision-making. The records have also supplied data needed by researchers in developing their models and by educators in their instructional efforts. Government has drawn upon cost accounting data for designing agricultural policy.

Although cost accounting data have a number of useful purposes, there are certain general limitations that should be discussed. First, there is not a single "perfect" cost accounting system. Each cost accounting system must be designed to encompass the goals desired from the records. Different goals will mean different cost accounting systems. Secondly, there is certain information that is nearly impossible to obtain from the cost account records. Among these are the derivation of production functions and prediction of future prices.

Cost Accounting from Farmers' Viewpoints

Cost accounts, if properly designed, can be useful in the management of a business. They can indicate areas of weak or poor management not indicated by other management tools and thus enable the farmer to take corrective action that he otherwise might not. In addition he will have information to use in completing income tax forms and other government papers, in obtaining credit, in adjusting insurance claims, and in bargaining for labor and commodity contracts.

Cost accounts are expensive to the farmer in time, money and required skill. The recording of the information needed for cost accounting requires more time than for other accounting systems. Likewise, unless the farmer has had training in cost accounting techniques and can do his own work, he will find it costly to hire the services of a knowledgeable accountant. The farmer can sometimes avoid the expense by engaging in university or government sponsored projects such as the one carried on at Cornell University. However, he has to sacrifice some flexibility because of the standardized system used by the institution.

Finally, cost accounting data of a farm business are not sufficient for all management decisions of that business. The farmer will have to rely on other sources of data (e.g., cost account records of other farms, budgeted figures) when deciding to make certain changes such as the adoption of new technology and new enterprises in the farm operation.

Cost Accounting from Researchers', Educators' and Governments' Viewpoints

The uses made of cost accounting data by the researcher and educator have been broad and varied. Educators have used the data in both extension activities and classroom instruction. Researchers have drawn upon the data for use in the newer management aids such as linear programming and simulation models as well as the established management techniques.

One of the problems faced by both researchers and educators in using the accounting information is the adaptation of the data to satisfy with his data needs. The researcher and educator are also concerned about the nature of the typical cost account cooperator. It is argued that anyone engaging in a cost accounting program is an above average farmer and, therefore, the data obtained from the record are not average. If it is desired, this upward bias partly can be overcome if the director of the cost accounting program selects his farms to minimize the bias.

Cost accounting has also been criticized because it is a relatively expensive means of collecting data. This criticism is probably warranted to some extent when the data actually used are considered. However, the data available for use far exceeds that which has been used and the cost per unit of data available is relatively low. New accounting techniques, particularly the use of computers in accounting, should make the data more readily available and make the cost of the data used relatively lower.

CHAPTER II

ECONOMIC CONCEPTS AND ACCOUNTING METHODS

In managing a firm the management must bear in mind the goals of the firm. These goals are often diverse and sometimes even inconsistent. Of the many existing goals, profit maximization (or loss minimization) is probably the major goal of most business firms.[1]

For firms having profit maximization as their goal the principles of economic theory will provide insight for its achievement. Economic theory states that maximum profit is achieved when marginal cost and marginal revenue are equated. (3:202) Knowledge of the production function and the price of the inputs is necessary for computing the marginal cost schedule; knowledge of the product demand schedule is needed to derive the marginal revenue schedule.

In the "real-world" of business, management does not have marginal cost and revenue information readily available. Furthermore, none of the existing accounting methods can supply this information for a number of reasons. First, many of the systems ignore such implicit costs as management and interest on investment. Also, many accounting systems are designed only to encompass the firm's entire operation and, therefore, have a multi-input and output analysis. Even in the cases of firms with accounting systems designed to examine costs and returns of individual commodities, such as cost accounting, it is not feasible for management to experiment with various levels of inputs in order to obtain the information needed for fitting a production function.

Management can look to other sources for production functions but again they will find them lacking except in a few cases.[2]

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[1] As Ferguson points out, the profit maximization hypothesis is a question that has been long debated but its merit rests in its success in explaining and predicting business behavior. (3:191) Friedman states that its repeated failure to be contradicted by any "coherent self-consistent alternative to be developed and widely accepted, is strong indirect testimony to its worth." Friedman further argues that if firms did not seek this goal they would lose resources and thus depend upon outside resources for continuation of existance. (4:21-23) Finally, Haynes argues that profit maximization is the "one persuasive objective running through all business situation; other objectives are more a matter of personal taste, or of social conditioning and are variable from firm to firm, society to society, and time to time." (6:8)

[2] Production functions have been computed using experimental data in some industries (e.g., agriculture) but even these are limited in number.

Accounting Methods and Management Information

Although management may desire marginal information, it usually will find that the average costs and revenue figures from accounts are the best alternatives available and, therefore, it is forced to depend upon accounting records for this management information.

Cash Accounting

Cash accounting is one method that is commonly used by businessmen. This method of accounting can supply management with a large number of average cost figures and analysis factors. A problem which exists with this accounting method is the aggregation of the revenue and expenditure figures. If there is only a single commodity being produced, as is the case for some firms, average cost per unit output can be computed for that commodity. These averages are helpful to management if it has a means of comparing the business with other similar businesses. However, if there are a variety of commodities being produced, the comparison technique is not possible and the accounting method can only indicate to management that the entire business is netting a profit or loss. The accounting method can not give management an indication as to which parts of the business are contributing to the profit goal.

Cost Accounting

Cost accounting is an accounting system designed to overcome the main problem of cash accounting--that of aggregation. The business is divided into sections and separate accounts are kept on each section. These sections purchase their own inputs and sell their own output. Therefore, average cost and revenue figures can be obtained on each section of the business. This technique provides management with much more decision-making information, both in costs and returns and in analysis factors.

Whenever the firm is divided into sections, intra-firm pricing becomes a problem. When one account uses an input which is the output of another, a value must be placed on the transferred item. Cost accounting methods in pricing intra-firm transfers should draw upon the economic concept of opportunity cost.[1] For many of the inputs used in production there exists an external market price which can be used as an opportunity cost figure. This figure establishes the returns to one account and the cost to another. The opportunity cost concept is also useful in integrating the cost of capital and management into the cost of production.

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[1] "Opportunity cost of producing one unit of commodity X is the amount of commodity Y (best alternative) that must be sacrificed in order to use resources to produce X rather than Y." (3:164)

In some other areas of costing such as for the many services or products used within the firm for which there is no market price, intra-firm pricing is more difficult. Again it may be desirable to apply the opportunity cost concept. In such cases the method of pricing is based on marginal information which is dependent upon the length of the time period under consideration. For example, if a new enterprise becomes a user of a product produced in an enterprise which is not being utilized to full capacity,[1] the effective cost to the new using enterprise should be an infinitesimal amount above the marginal cost of the supplying enterprise. The supplying enterprise is satisfied to cover only a small proportion of the fixed costs and the new enterprise is the best alternative available.

If the supplying enterprise is not in a state of excess capacity, then the transfer price will depend upon the marginal value product of the input. The supplying enterprise will sell its product to the enterprises with the highest marginal value product until full capacity is reached. If the capacity is fixed, then enterprises with a marginal value product less than the last using enterprise will have to be eliminated. If capacity can be expanded, this should be done and should continue until the marginal cost of the product of the supplying enterprise is equal to the marginal value product of that product as an input in other enterprises.[2]

Although the pricing methods for intra-firm transfers based on marginal information are most desirable, as stated earlier, such information is not obtainable from cost accounting data. Therefore, other pricing techniques based on average costs are used.

The technique for pricing products or services for which there is no market value is to charge the average cost of producing or supplying the service or product. In cases in which the supplying enterprise is being utilized at less than full capacity, it is desirable that the costs of the enterprise be divided into two segments--fixed and variable. The division of the costs are important in the making of management decisions. Management that does not divide costs between fixed and variable may arrive at a different decision than if it did.

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[1] Full capacity is defined as that level of output in which total average cost of the given plant is equal to the total average cost of the next larger scale plant.

[2] In designing an accounting system to aid in the management of large Israelian farms Goldschmidt has a thorough discussion of intra-farm pricing techniques and the history of their development. (5:130-155)

For example, in the short-run if the managers of a firm look only at total cost and returns for an enterprise and find that there is a net loss, they will be encouraged to eliminate that enterprise. Whereas, if the costs are divided into fixed costs, over which management has no control in the short-run, and variable costs then the management will be encouraged to continue the enterprise as long as the returns cover the variable costs and contribute to the payment of the fixed costs.

In the long-run all costs, including fixed costs, become variable and management must then consider all the costs in adding or eliminating an enterprise. However, the separation of the fixed and variable costs also aids management in making long-run decisions. As in the above example, there are enterprises in which the average revenue exceeds the average variable cost but not the average total cost.

In making long-run decisions, if the enterprise is not being operated at full capacity, management will recognize that as production is expanded fixed costs per unit will decline and total costs could reach a point at which average revenue equaled average total cost and the enterprise would be profitable. Management will also have to recognize, however, that depending on the market structure, average revenue and variable costs may also change as production is expanded.

CHAPTER III

THE THREE FARM COST ACCOUNTING RECORDS

Three separate records, the inventory, supplemental data record and financial record are needed to obtain necessary information. Each is designed for a particular function and the system would be incomplete without the data from each.

The Inventory

An inventory, in general terms, can be defined as a statement of a firm's assets, liabilities and net worth at a given time. It is a necessary ingredient in most modern accounting systems because it allows the accountant to translate expenses and incomes into rate figures that are expressed in time units.

The importance of an inventory can be readily noted by a simple illustration. Let us suppose a firm had sizable assets in equipment, raw materials and finished products and during the following accounting period the management liquidated the entire inventory. Anyone examining only the expenses and receipts of the firm would conclude that the firm was very successful in the period of liquidation. A similar example could be portrayed with a firm that was building up its assets and the opposite conclusion reached.

The inventory must, therefore, be integrated into the financial records. This can be achieved by making the assets of the beginning inventory debits of the firm and the liabilities and net worth credits of the firm. Likewise, the ending inventory assets are handled as credits and the liabilities and net worth as debits. This procedure can easily be grasped if one thinks of the inventory as a "market" that is willing to sell the firm its assets and buy its liabilities and net worth at the beginning of the accounting period and purchase the remaining assets and sell back the remaining liabilities and net worth at the end of the accounting period. By this method any changes in the inventory will be reflected in the expenses and incomes of the firm.

Of course, a firm does not actually invest in a business at the beginning of the accounting period and dissolve it at the end of the period. However, this does not preclude an accountant from acting as though such a condition exists and setting the beginning and ending inventory value on market values as of those dates.

Market values are used in the inventory. The values are set by the farmer at the end of each accounting period. They should reflect rising or dwindling values. The farmer's ability or lack of ability to make a good investment decision should be considered part of the firm's overall profit situation.

The farm cost accounting inventory is divided into sections corresponding to the enterprises of the financial records. This division causes no problems except for the division of real estate. Real estate items are generally not sold separately but as a unit and yet these need, for accounting purposes, to be valued separately. In this process the farmer usually places values on the individual real estate items such that the sum of these items is greater than the value the farmer places on real estate as an entity. The procedure followed in such cases is to devalue all real estate items proportionately so that the sum of the value of the parts equals that of the whole.

In the new farm cost accounting system the forms the farmer receives at the end of the accounting period for updating are printed via a computer. In order to aid the farmer in setting values for the inventory items the forms contain such helpful information as the age of the inventory, number of years owned and previous inventory values.

The Supplemental Physical Data Record

There are many intra-farm transactions taking place on a farm daily. It would be an overwhelming process for the farmer to value these daily transfers and to debit and credit the appropriate accounts. To simplify the process the farmer records the physical information of the transfers on a daily basis in the supplemental physical data record. The daily recorded data are summarized at the end of the accounting period and then used in making intra-farm transfers.

The form the farmer has for recording these data is designed so that he can record labor, tractor, truck, auto, special equipment usage and input-output quantities of other goods and services by enterprise (Figure 1). The farmer's coding should be checked and the information then stored on magnetic computer tape.

To assist in recording the physical data and in the accounting for production activities it is desirable to have a farm map. This can be used to record activities and as a basic reference source.

The maps can be obtained from a sketch, engineering survey or aerial photograph. The latter, where available is the cheapest and most accurate.

The best scale for most maps is 660' to the inch. This is small enough to accommodate most farm business areas on one sheet and at the same time the scale is large enough to enable the redording of information on the map. This scale is such that 1 square inch on the map equals 10 acres, thus, enabling relatively easy acreage measurement via the use of a dot grid or planimeter.

In the preparation of the map each field should be delineated, measured, and given a number. This numbering and acreage enable the recording and reference by fields and the acreage information enables the computation of analysis factors.

The Financial Record

In the early stages of planning this farm cost accounting project the Department of Agricultural Economics initiated its mail-in Farm Business Management Electronic Accounting Program. It was decided that there would be several advantages in making use of the cash accounting records of this program as the primary financial record. Some of the advantages of using this program included consistency of financial records used by the Department, ease of selecting farmers to participate in cost accounting, ease of conducting partial enterprise accounting.

The Farm Business Management Electronic Accounting Program provides for cash and credit transactions, capital and operating designation of expenditures and receipts and can include the accounting for household and other non-farm activities. These are coded under the "credit code" and "transaction code - major and modifier". The codes which are used are:

Transaction

Major		Modifier	
1.	Farm income	0.	Unclassified
2.	Farm expense	1.	Non - capital
3.	Credit account transaction	2.	Capital
4.	Non-farm income	3.	Reduction of credit account
5.	Family expense	4.	Increase of credit account
6.	Reports	5.	Inventory
		6.	Production
		7.	Loss

There is also an "Item" code which provides for a series of categories and sub-categories of expenses and receipts. Under the item code there are two classifications -- category (2 digits) and detail (2 digits). The category broadly classifies and the detail specifically classifies the item being entered. These codes enable the use of the computers to sort and summarize the expenses and receipts into meaningful totals.

NEW YORK FARM COST ACCOUNTS
SUPPLEMENTAL PHYSICAL DATA RECORD

Name _____ Farm No. _____ Page No. _____

Line No.	Date	Job	Ent	Oper	Field	Sub FD	Spec Man		Reg. Man		Tractor		Truck		Auto		Sp Equip		Quantity	
							No.	Hrs.	No.	Hrs.	No.	Hrs.	No.	Mil.	No.	Mil.	No.	Hrs.	No.	Vol.
1																				
2																				
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Figure 1. MAIL-IN SUPPLEMENTAL PHYSICAL DATA FORM

In order to make use of the electronic cash accounting program for enterprise cost accounting some special provisions had to be made. It was necessary to make allowance on the input cards for handling up to one thousand enterprises and up to one hundred operation codes. Also, some code changes were needed. The cash accounting program had no codes for intra-farm transactions and these had to be added. Some description codes were lacking or confusing and new codes were added while others were deleted to remedy the problem.

The financial information of the farms is recorded on standard Farm Business Management Electronic Accounting program forms (Figure 2). These forms are mailed in weekly and in return the farmer receives a monthly financial statement on his farm business. Included in the monthly financial statement are selected business analysis factors, comparison of the present year's expenses and incomes with that of the previous year, and a statement of cash flows. At the end of the year all the financial transactions of the cost account farms are separated from non-cost account farm transactions and the transaction data are transferred to a magnetic computer tape.

FARM BUSINESS MANAGEMENT
ELECTRONIC ACCOUNTING PROGRAM
Cooperative Extension-New York State
Cornell University-Department of Agricultural Economics

Page No. _____

NAME _____ FARM NUMBER _____

ADDRESS _____ MONTH _____ 19___

Line No.	Day	DESCRIPTION AND SOURCE		Credit Code	Trans Code		Item Code		Enterprise Code	Oper. Code	Quantity		Dollar Amount
		What	Who		Major	Modifier	Category	Detail			Vol.	Unit	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													

Figure 2. MAIL-IN FINANCIAL FORM

CHAPTER IV

SUMMARIZATION AND ANALYSIS OF THE FARM COST ACCOUNTING INVENTORY

Analysis of the inventory is a rather weak management tool. It summarizes the assets, liabilities and net worth of the farmer at a given point in time. Comparisons of the inventory with inventories made at other dates can indicate changes which have occurred but will not give information as to what may have caused these changes.

Summarization of the Inventory Records

The first step in using the inventory is to summarize the record. As previously noted little use can be made of the inventory records as a management tool, and its main purpose is in relating to the financial records. Therefore, the record is summarized in a manner that will supply the necessary information for the financial records. Items are grouped and summarized into categories that correspond with the enterprises of the financial records. Additional summarization is only that involved in arriving at the analysis factors and supplying a one page concise summary for such uses as obtaining credit for the farm business.

Analysis Factors of Inventory Records

Some analysis factors which may have value as management tools can be computed from the inventory. These are:

1) Change in net worth of the farm operator

2) Size indicators

   a) Total investment of farm

   b) Number of total acres

   c) Number of crop acres

3) Investment ratios

   a) Value of real estate to total value of farm

   b) Value of equipment to total value of farm

   c) Value of livestock to total value of farm

   d) Investment per crop acre

One of the common measures of a firm's success has been the growth rate of the net worth. In owner-operated businesses such as farms, the personal finances of the operator are intermingled with the finances of the business. For example, it is possible for the farmer's farm net worth to increase while in reality the farm business has lost money for the accounting period because the farmer has shifted capital from non-farm sources into the farm operation. One can only conclude that this performance measure should be examined with caution.

The number of size indicators of a business are many. The three computed from the inventory are commonly accepted as descriptive size-of-business indicators on most New York State farms.

Finally, investment ratios have long been used to locate possible problem areas of the business. The process has been to make comparisons of individual farm ratios and ratios of similar type farms. A major difference between the two is assumed to be an area of investigation. The investment ratios computed are general in nature and basically a continuation of ratios computed in the past.

CHAPTER V

SUMMARIZATION OF THE FARM COST ACCOUNTING SUPPLEMENTAL PHYSICAL DATA RECORDS

Summarization of data supplied by the supplemental physical data records is related to the end use of the data. The procedure is designed primarily for the purpose of supplying physical input and output information for the financial accounts where it serves as a basis for intra-firm transfers and the computation of physical efficiency factors.

The phsyical information needed in the summary and analysis of the financial accounts is listed below:

1) Adjusted hours[1] of tractor usage from each tractor account by each enterprise, operations of using enterprises, fields of operations and sub-fields of fields;

2) Adjusted miles[1] of truck usage from each truck account by each enterprise, operation of using enterprises, fields of operations and sub-fields of fields;

3) Miles of auto usage from each auto account by each enterprise, operation of using enterprises, fields of operations and sub-fields of fields;

4) Hours of special equipment usage from certain special equipment accounts by each enterprise, operations of enterprises, fields of operations and sub-fields of fields;

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[1]The recorded hours (miles) of usage by each using enterprise, operations of enterprises, fields of operations and sub-fields of fields are adjusted by the following formula

$$A_E = R_E \cdot \left(\left(\sum_{E=1}^{n} R_E \right) / U \right)$$

where

A_E = Adjusted recorded usage by E

R_E = Actual recorded usage by E

U = Total hours (miles) usage as recorded on tractors' (truck's) hourmeter (odometer)

n = Number of users of tractor (truck)

5) Input and output quantities of each enterprise, operations of enterprises, fields of operations, and sub-fields of fields;

6) Hours of labor usage from each labor account by each using enterprise, operations of using enterprises, fields of operations, and sub-fields of fields.

As noted above, although the data from the supplemental data records are summarized in a pattern for supplying needed information for the financial records, this does not rule out the possibility of summarizing the data in another manner for use in other research.

CHAPTER VI

FARM COST ACCOUNTING FINANCIAL RECORDS; INTRODUCTION AND OVERHEAD ACCOUNTS

The proceding two chapters have been concerned with the summarization of the inventory and supplemental physical data records. The summarization of these records is directed in such a manner that they furnish information needed in the cost allocations and analysis of the financial records. This, in essence, states that the major emphasis is placed on the summarization of the financial records.

Before the subject of summarization and analysis of the financial records could be approached, guide lines had to be defined. There are many desirable methods of summarizing the records for research and instructional purposes. Thus an examination of the farmers' and others' desires in record keeping is of prime concern in deciding the direction in the summarization of the records. Assuming that, as is usually the case with businesses, the farmer's major interest in the records is to aid him in profit maximization, the records should be summarized in a manner which will indicate which enterprises are contributing to this goal and which are not. Without obtaining such information from the accounts, the farmer would have much less incentive to keep detailed records. Researchers and educators are also interested in management data on farm businesses and thus are willing to have the records summarized in a similar manner.

In addition to profit maximization, the researcher, extension teacher and farmer are interested in using the summary for study of the relative importance of items and measures of efficiency of production.

Thus, the financial record should be summarized with the primary objective of supplying management information but with other uses in mind. To help in designing the method of summarization the management concepts outlined in Chapter II were used. The records were designed to provide fixed and variable costs and returns on the farmers' enterprises and a number of business analysis factors.

The business analysis factors chosen to be computed from the records are basically the same as those used in the previous farm cost accounting system. There are two reasons for this: 1) the continuation of historical data was important; 2) these analysis factors have grown out of years of experience and are basically sound. As time passes, some of these factors will become obsolete and replacements must be found.

Summarization and analysis of the cost account financial records is done at the enterprise level. However, before efforts can be applied at the enterprise level, it is necessary that the enterprise boundaries be clearly defined. One factor which aided in the determination of these boundaries was the existence of a logical or convenient dividing point. Market prices, when available,

provided this dividing point. For example, a farmer raising dairy heifers for replacements in his cow herd generally may choose between two alternatives: 1) he can sell the mature heifer at the local livestock market or 2) he can use the mature heifer in his own cow herd. The market provides the farmer with an opportunity cost figure and thus a logical point of division for the dairy enterprise; the first being the dairy replacement account, the second being the milk production account. If the market did not exist, then it could be argued that there would be no necessity of separating the dairy operation into two parts. The argument would be that the raising of dairy replacements is an essential element of the milk production account and, therefore, should be carried as a cost of producing milk.

The existence of an opportunity cost was not the only factor which designated a logical or convenient dividing point between enterprises. Tractor and truck enterprises provide examples of enterprises which usually lack market values for their services. But, since many enterprises make use of such equipment, there should be a separate enterprise accounting so that the costs of the equipment can be accumulated and then spread out to the enterprises making use of the equipment.

Another factor to be considered in determining where to divide the enterprises is what information is desired for the analysis of the account and what is actually necessary. It may be desirable from an academic point of view to have an enterprise delineated at a certain point, but, from the practical point of view, it may not be reasonably possible to obtain the necessary information for such a delineation on commercial farms in New York State. The resolution of the problem of getting the 1) information which is of major importance in the analysis of the accounts and 2) that which is feasible considering the willingness of farmers to keep the records becomes a compromise. The farmer will record all information that he considers necessary. If the program demands too much information beyond this level, he may become discouraged and not keep the records. On the other hand if the records do not include enough information they will be of limited value. Finally, the above considerations in determining the enterprise division are not mutually exclusive but need to be considered as a unit.

The standard enterprises which have been developed to be used in New York farm cost accounts are based on the factors discussed above. They can be grouped into four categories: 1) overhead accounts; 2) allocation accounts; 3) production accounts; 4) miscellaneous accounts. The purpose of the accounts as well as the method of summarization and analysis then will be explained further in this and the following two chapters.

The order of discussion of the accounts will somewhat parallel the simplest order for closing accounts. In theory it is not important which accounts are closed first, but the work is facilitated by closing those accounts first which affect the greatest number of other accounts. Thus the service or overhead accounts would be the first to be closed.

Overhead Accounts

Included within overhead grouping of enterprises are the labor accounts, power and equipment accounts, and real estate accounts. These are important in three respects. First, they are accounts for accumulating costs and subsequently passing these costs on to enterprises utilizing the services furnished by the enterprises. Secondly, the analysis of these accounts is important in the management of the farm business. The expenses associated with them are sizable and, therefore, an important area of cost control. Finally, the accounts supply rates and ratios needed in partial enterprise accounting.

Two alternative means of handling these accounts are possible. The first is to accumulate costs as debits and to close the accounts by allocating the total of the costs to the enterprises on which the services are used. Several problems and undesirable features are involved with this system. Because management decisions are influenced by the nature of the costs, separation of these into fixed and variable is desirable. This complicates the allocation. There is the problem of the separation and the added work of making allocations of the two separate parts. More serious is the question of deciding the portion of each type of cost to be allocated to each using enterprise. The variable costs in a service account can logically be charged in proportion to use. The fixed cost allocation is more difficult.

It can be argued that the fixed costs should be charged to the primary enterprise requiring the service. Or, it can be argued that all fixed costs should be closed to the loss and gain account. In the former case there is the difficulty of determining which was the primary enterprise. On an individual farm basis this would be extremely difficult and time consuming. In the latter case, because these are "sunk" costs, it is assumed that none of the enterprises should carry any of the fixed costs. This assumption is not correct because in many of the accounts "fixed" resources are continually being purchased or traded for more modern ones, and thus in effect making them variable costs.

A further problem in the allocation of the costs accumulated in the service accounts to other accounts is that it results in the transfer of the effect of mismanagement in one activity to another.

The second alternative is to accumulate costs in the service account and subsequently credit the account and charge the using enterprise with these services at the opportunity cost of obtaining them. The account would then be balanced to the loss and gain account at the end of the fiscal year or accounting period. Because allocation can be made at any time during the accounting period and because poor management or inefficiencies are not passed on to the using enterprise, this is a superior means of handling the allocation of the overhead accounts. Unfortunately it is often very difficult, if not impossible, to obtain opportunity costs for some services on the farm. Also, there is the problem of having to decide between a "sale" price and a "purchase" price.

Thus, in spite of the problem of separating the fixed and variable costs in making the allocation and of making a reasonable allocation of these to the using accounts, the allocation of costs accrued in the service accounts to the using accounts on the basis of amount of usage seems to be the most feasible method. This is true of both fixed and variable costs.

Labor Accounts

Labor is one of the major inputs of a farm business. Although the number of man equivalents[1] per farm has remained about constant on New York farms, the output per man equivalent has increased substantially. (20:1-5) In 1946 the average man equivalent for New York farms was 1.95 and in 1968 it was 1.7. In about the same period the productive man work units[2] to care for cows decreased from 16 in 1947 to 8 in 1968; for corn silage the change was from 3 to 1; and for hens it was from 0.2 to 0.04. At the same time that labor requirements were decreasing, wages were rising more rapidly than many other prices and, thus, the financial savings were less than the reduction of time might imply. Even though the net effect of these changes is a decline in importance of labor as an input to the enterprises, the analysis of these accounts remains important because for some enterprises it is still a sizable cost input.

Number of Labor Accounts Needed

The number of labor enterprises needed depends upon the level of accuracy desired for the records. One account would be sufficient if the farm labor were fairly homogeneous in skill and wages paid and the demand on the labor were not highly seasonal. However, differences do exist on many farms and, thus, separate labor accounts are required for special labor (e.g., piece workers) and skilled labor (e.g., foreman and workers of the poultry enterprise).[3] Having different labor accounts for labor with differing skills and rates of pay allows for more accurate allocation of the labor costs to the enterprises drawing upon the service.

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[1] Man equivalent is defined as the employment of a worker for a twelve month period.

[2] Productive man work unit is defined as the average amount of productive work accomplished by an average worker in ten hours.

[3] One suggested division of the labor accounts on a skill basis is that between manual labor and management. This suggestion was set forth by Hughes (8:51-53) but no action was taken along this suggestion in this project. However, provisions have been made in order that this line of endeavor can be pursued in the future.

Seasonal demand for labor is also a reason for sub-dividing the labor account on some farms. If the labor resource of the farm is fixed in supply, the greater the demand for labor during some seasons of the year the higher the price the demanding enterprise should be forced to pay to obtain labor services. The problem of what rate should be charged when the demand for labor is high can be determined if the farm has been linear programmed with the quantity of labor of different periods used as fixed restrictions in the linear program model. The shadow prices of the fixed labor restrictions, if any, will set the appropriate rate to charge enterprises using the labor resource. However, the number of cost account farms having been worked into a linear programming model is small and it is not likely that this method of determining differential labor rate will be readily available in many instances. Therefore, the problem of establishing seasonal rates will still exist on most cost account farms.

If the labor account is not divided into more than one account because of seasonal demand for labor and a constant labor rate is used throughout the year, then the farmer in the management of his business will be more inclined to search for enterprises which will reduce the seasonal demand for labor. Because the use of average rates is desirable under most cases, but differences for seasonal demand for labor is best in other cases, the accounting methods should provide for the use of either at the discretion of the farmer.

Costs and Returns of the Labor Accounts

The costs and returns of a typical labor account are shown in Table 1. All labor expenses are cash or opportunity costs and, hence, there is no need for division into fixed and variable costs.[1] Because of this the account can be closed at cost to the using enterprise with labor as a variable cost to those enterprises. There are cases in which labor is fixed in nature. Such a case exists when labor is hired on a yearly basis and is fully utilized only part of the year. In such a case the enterprises drawing upon labor during the periods of under-utilization might not be charged for the labor used. However, the task of determining periods of full and partial utilization of labor would be tedious and difficult on an individual farm basis. For this reason, the simplifying assumption that all labor is variable is used in making the allocations.

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[1] There may be a small amount of fixed costs present in the account, but the proportion of these to the total cost will be small.

Table 1. LABOR ACCOUNT I

Debits			Credits			
Cash Wages		$5,000.00	Enterprise A	2,000	Hrs.	$4,000.00
Social Security		220.00	Enterprise B	500		1,000.00
Privileges		780.00	Enterprise C	300		600.00
1) Housing	$600		Enterprise D	200		400.00
2) Food	50					
3) Insurance	100		Total Hours	3,000		
4) Other	30					
Total Debits		$6,000.00	Total Credits			$6,000.00

The credits of the labor account were computed using the following formula:

$$TC = \sum_{x=1}^{n} (TD \,/\, \sum_{x=1}^{n} H_x) \cdot H_x$$

where

TC = Total credits of labor account

TD = Total debits of labor account

H_x = Hours of labor usage by enterprise X

n = Number of enterprises using labor from account

Analysis of the Labor Account

The computation of analysis factors on individual labor accounts would be of little value because of the lack of homogeneity of labor on farms. However, an analysis of the entire situation of the farm has relevance because comparable factors between farms can be computed.

For analysis the entire farm labor supply is separated into four groups: 1) operator's labor; 2) regular hired labor; 3) day and hour labor; 4) unpaid labor.

The following analysis factors are computed:

1) Per month (1/12 man equivalents) of operator's labor
   a. Number of man equivalent
   b. Wage cost
   c. Social Security cost
   d. Privileges cost
   e. Total cost

2) Per month (1/12 man equivalents) of regular hired labor
   a. Number of man equivalents
   b. Wage cost
   c. Social Security cost
   d. Privileges cost
   e. Total cost

3) Hours worked per 12 month equivalent of operators' and regular hired labor.

4) Average total cost per hour of operators' and regular hired labor.

5) Per hour day and hour labor
   a. Number of man equivalents
   b. Wage cost
   c. Social Security
   d. Privileges
   e. Total cost

6) Unpaid labor
   a. Number of man equivalents
   b. Cost per month (1/12 man equivalent)

7) Total man equivalents of all labor

8) Cost per month (1/12 man equivalent) for all labor

9) Cost per hour worked of all labor

Power and Equipment Accounts

The power and equipment accounts are designed to determine the costs of owning and operating such capital items.[1] With increased mechanization of farms such accounts have grown in importance and in number. The following discussion sets forth the methods to be followed in using power and equipment accounts.

Number of Power and Equipment Enterprises Needed

In the past a fair amount of aggregation of equipment in enterprises has been done. However, with the increase in specialized equipment that is occuring there is a need for a larger number of equipment enterprise accounts than in the past. This will simplify the accounting and increase the accuracy of allocation of equipment costs. The minimum number of tractor and truck enterprises should be equal to the number of different sized tractors and trucks found on the farm. It is also desirable that items of equipment having a high cost of operation, such as fruit sprayers and combines, be considered as separate enterprises. The remaining equipment should be grouped according to specialized use (e.g., dairy equipment, corn growing equipment and hay harvesting equipment) and each group assigned to a separate enterprise account.

Although there is a minimum number of equipment accounts that should be kept, the only restriction on the maximum number is the number of enterprise codes available within the accounting system. It is probable that this limit will not be restrictive because a more immediate limitation will be the operator's willingness to record the additional information required for a further break down of the equipment accounts.

Debits and Credits of the Power and Equipment Accounts

The approach taken in the using of power and equipment accounts differs from that of the labor accounts. The simplifying assumption that all costs are variable can not be applied to the power and equipment accounts. There are certain costs that are generally accepted as fixed. (5:431) These include insurance, any existing taxes and interest on investment. Variable costs are those incurred through operation of the equipment.

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[1] The operating costs do not include the man labor in using the equipment but do include the labor of repair and maintenance.

There are two costs which can not be precisely categorized as either fixed or variable. These are buildings costs and gross depreciation. The separation of these costs into two segments, fixed and variable, is a problem. The proposed solution for the building account will be discussed later in the section on the building accounts.

Previous attempts in the separation of fixed and variable depreciation has been done mainly on a subjective basis. Haynes (6:215) acknowledged that variable depreciation is difficult to estimate and made no suggestions of how it might be done; Keynes (12:66-75) presented a thorough analysis of variable depreciation but also did not suggest any method for arriving at its value except by subjective judgment. Although subjective separation of fixed and variable depreciation is in most cases superior to non-separation, there are other approaches that are more objective.

It can be hypothesized that fixed depreciation is a result of obsolescence and variable depreciation a result of wear and tear. It can further be hypothesized that a high correlation exists between fixed depreciation and age of equipment and between variable depreciation and annual rate of usage and age (Figure 3). Therefore, age and annual rate of usage can be used as proxy variables in estimating fixed and variable depreciation.

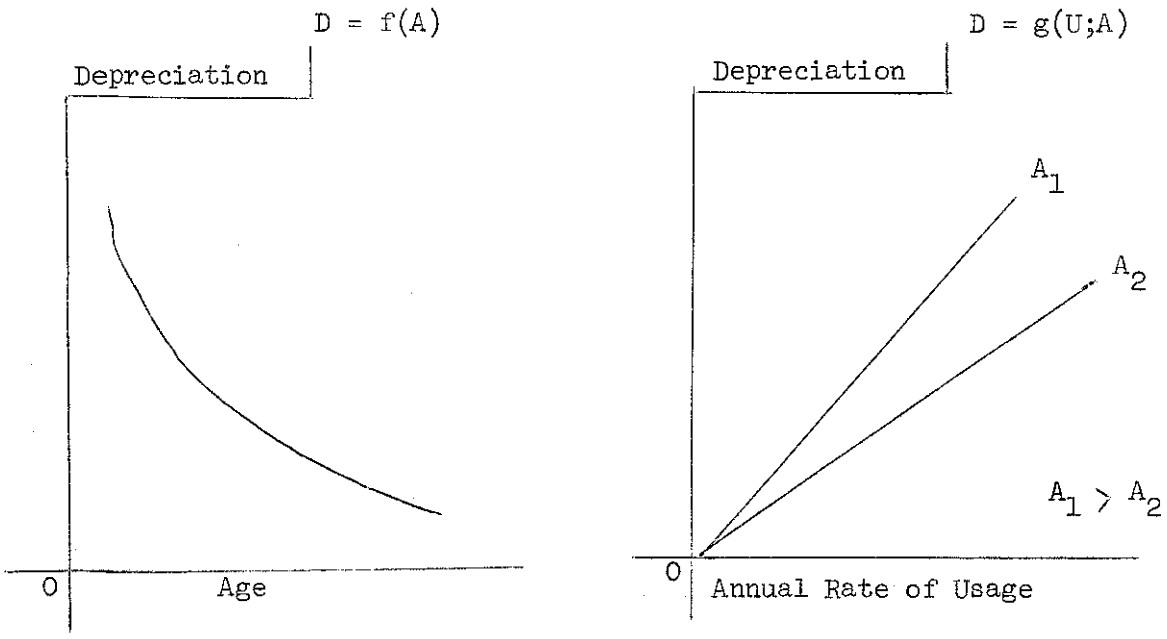

Figure 3

Depreciation of Equipment Related to Age and Annual Rate of Usage

Obsolescence has two parts, technological and psychological. Technological obsolescence comes into being as more efficient machines are developed and as raw materials and products are changed. Therefore, the older machines drop in value. Psychological obsolescence is that related to initial and second hand ownership. As example of the latter type of depreciation is that of an individual purchasing a new automobile. If the owner merely drives the new car "around the block", and then attempts to sell it he can do so only at a price substantially lower than the purchase price. This would be true even if the warranties were transferable.

To ascertain the proportions of the depreciation cost attributable to the various causes, data was used from the 1966 New York Farm Cost Account records. (2:28-35) These data included the annual rate of usage (hours per year), age, and gross depreciation of tractors.[1, 2] Although the total number of tractors was sufficient for a multiple regression analysis, the number of tractors in each size group was not.

To make the data homogeneous, adjustment of the gross depreciation figures was necessary to allow for differences in sizes of tractors. The gross depreciation figure for each observation was divided by a size index. This index was computed from USDA (19:29) and Tractor Guide (16:45-215) figures using the average new tractor cost for the size of tractor to which it was applied.

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[1]Gross depreciation was computed by the following formula:

$$D = B + R - E$$

where

D = Gross Depreciation

B = Beginning inventory market value of tractor

E = Ending inventory market value of tractor

R = Total yearly repair costs of machine (includes parts, tires and maintenance labor cost)

The inclusion of repair costs as part of depreciation is not considered conventional. However, to obtain a total depreciation figure for the year, they must be included. To illustrate this point, consider the farmer who does a major overhaul on his tractor. It is possible that the ending inventory would be greater than the beginning inventory value because the tractor is now in a better state of repair. If only inventory values are used to compute depreciation, then the depreciation is negative for that year. However, by adding the cost of the major overhaul the depreciation figure will again become positive.

[2]Tractors were chosen in this analysis for two main reasons. The first is that tractors were one of the few items of equipment for which this type of data was obtainable. The second is the fairly large number of observations available so that sufficient variation in data existed.

It would be ideal to use the adjusted gross depreciation as the dependent variable and age and a composite age and annual hours of usage as independent variables in a multiple regression analysis. However, the inclusion of age in both independent variables causes the condition of multicolinearity to exist. To overcome this problem the data can be grouped according to hours of annual usage into one-hundred unit intervals. A separate equation can be computed for each group with adjusted gross depreciation as the dependent variable and age as the only independent variable. This procedure in effect isolates the effect of annual rate of usage on depreciation. A comparison of the equations should indicate the additional gross depreciation that can be attributed to usage and whether or not use depreciation varies with the age of the machine.

The results of the equations indicate that the gross depreciation related to use does not vary with age of the machine. This would suggest that the hypothesis that variable depreciation is a function of age as well as usage be rejected. It appears that variable depreciation is mainly related to the usage of the machine. This simplifies the analysis because it is possible to compute the following equation directly without the problem of multicolinearity.[1]

$$Y = -43.34 + \underset{(37.36)}{234.78}\ \frac{1}{\sqrt{A}} + \underset{(.053)}{.087U}$$

$$R^2 = .53$$

where

Y = Gross depreciation (D) divided by average new tractor cost for that size tractor

A = Age of tractor

U = Annual hours of usage of tractor

Although the method just described places the separation of fixed and variable depreciation on an objective basis, it still has limitations and problems. One problem is that the estimates of the beta coefficients may deviate from the true population parameters. Another problem exists when there is a need for aggregation of data.[2] Finally, problems exist when there is insufficient data available for estimation of the beta coefficients. This could exist because the farmer does not know the usage rate or exact age of the machine or because there is limited variation in the dependent variables.

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[1] The beta coefficients of age and hours of usage were found to be significantly different from zero at the 0.05 and 5.0 percent level of significance respectively using a one-tailed t test.

[2] In obtaining beta coefficients for tractors there was an aggregation of different sizes of tractors, different brands and different fuel types and features among brands.

When this approach is applied to equipment other than tractors, the problem of insufficient data becomes really serious. It would be desirable to develop the specific equations for separating fixed and variable depreciation for tractors into a generalized model for all equipment. To do this it would be necessary to change the model in order that all equipment accounts would be able to supply the necessary data for the estimation of fixed and variable depreciation. A comparison of the age and average inventory value (beginning inventory market value plus ending inventory market value all divided by two) of tractors indicates that these are highly correlated. Therefore, it is possible to substitute average inventory value for age.

To determine the relation of average inventory values to fixed depreciation for tractors the first step was to compute the values of each for each tractor. Then the data were grouped at six hundred dollar intervals and means for each were computed. The means of the average inventory values were then related to the means of the average fixed depreciation values and the following equation was obtained using least squares linear regression with the constant term forced to zero.[1]

$$DF = \underset{(0.008)}{0.135} I_A$$

$$R^2 = .95$$

where

DV = Variable gross depreciation of equipment

DT = Total gross depreciation of equipment

DF = Fixed gross depreciation of equipment

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[1]Two restrictions were in effect when solving for this regression equation. The first was that the equation had to pass through the origin. Logic indicates this has to be the case. It is difficult to have either positive or negative fixed gross depreciation when the value of the machine is zero. Secondly, only a linear equation line was acceptable. The reason is that there are many different machines in a single account with different average values. It is necessary that the computed fixed gross depreciation of each machine adds to the same figure if computed on the whole account. A linear equation passing through the origin meets this condition.

When gross depreciation is separated into fixed and variable gross depreciation using the proceding equation, they can be added to the other fixed and variable costs of the equipment accounts (Table 2).

Table 2. EQUIPMENT ACCOUNT I

Debits			Credits		
Fixed Costs		$1000	Fixed Cost Allocations		$1000
1) Gross Dep.*	$710		Loss (20%)	$200	
2) Insurance	$ 50		Enterprise A (40%)	$400	
3) Interest**	$180		Enterprise B (24%)	$240	
4) Building*	$ 60		Enterprise C (12%)	$120	
			Enterprise D (4%)	$ 40	
Variable Costs		500	Variable Cost Allocations		500
1) Gross Dep.*	$160		Enterprise A (50%)	$250	
2) Fuel	$285		Enterprise B (30%)	$150	
3) Oil, Grease, etc.	$ 50		Enterprise C (15%)	$ 75	
4) Buildings*	$ 5		Enterprise D (5%)	$ 25	
Total Debits		$1500	Total Credits		$1500

* These are computed costs.
** Present interest rate multiplied by average inventory value.

The main concern for dividing the costs between fixed and variable is related to the fact that equipment rental rates are not readily available. This of course implied that the use of opportunity costs in making allocations from the equipment accounts is not practical. The equipment enterprise costs are, therefore, transferred to the enterprise making use of the equipment.

In making the allocation of the costs in some cases the basis can be fairly objective. For example, fitting equipment costs can be allocated on the basis of acres fitted. For other specialized equipment (e.g., dairy equipment) the proportion of the costs to be charged to the enterprises is generally on a subjective basis. The method may not be precise but it is simple. Also, the amount of error in allocation of the costs is not large because in most cases equipment is specialized for a particular enterprise and the amount of use for other accounts is small.

For some specialized equipment more detailed allocations of cost are justified. Special equipment (e.g., orchard sprayers and combines), having high costs and being used by several enterprises, fall into the latter category. The usage of such equipment should be recorded in the supplemental physical data record and this information used to allocate cost. The following formula should be used to allocate fixed and variable costs of special equipment to the enterprises using the equipment:

$$TC = (FC.P_L) + \sum_{X=1}^{n} ((VC . P_X) + (((FC - (FC.P_L)) . P_X))$$

where

TC = Total credits of equipment enterprise

VC = Total variable costs of equipment enterprise

FC = Total fixed costs of equipment enterprise

P_X = Proportion of total usage by enterprise X - P_X is computed for some equipment from the supplemental physical data record by the formula given below

$$P_X = \left(\sum_{X=1}^{n} H_X \right) / H_X$$

where

H_X = usage as recorded in the supplemental physical data record by enterprise X

n = number of enterprises using equipment

P_L = Proportion of equipment fixed costs that should be charged to the loss account because equipment was used less than normally

n = Number of enterprises using equipment

The allocation of the fixed and variable costs of the tractor and truck accounts should be made on the adjusted miles or hours recorded in the supplemental physical data record. The same formula should be used as that recommended for special equipment.

The auto accounts credits should be handled in a different manner because of the special nature of the investment. It is not uncommon for the auto to be both a personal and a farm investment. Since there is variation among farmers in the value and cost of operation of the autos they own, a standardizing procedure should be used to prevent farmers' preferences from being passed on to farm enterprises. A fixed cost per mile multiplied by the miles recorded in the physical data record should be charged to the farm enterprise. The fixed charge is the same for all farms and reflects only the variable cost of the auto operation. The auto account should then be balanced by closing the account to the personal account. If the auto account is one in which the auto is operated for farm business use only, the same procedure can be followed with the exception that the account should be balanced with a closing entry to the general expense allocation account.

Analysis of the Power and Equipment Accounts

Comparisons which can be made among types of equipment are few. This stems from the fact that most equipment has been designed for the production of a limited number of different commodities. Each type of equipment will have analysis coefficients that are not comparable to those for other types of equipment. Also, because the equipment is specialized in function, the important analysis is the value of output per dollar of equipment cost.[1] This ratio can be best computed in the production accounts.

Equipment such as tractors and trucks which are not engineered for specialized production uses provide exceptions. It is, therefore, possible to make comparisons among tractor and truck enterprises on farms. Below are analysis factors which can be computed from each tractor and truck account.

Analysis factors of tractor and truck accounts:

1) number of machines in account
2) average per machine
    a) use
    b) inventory value
    c) fixed costs
        1) computed net depreciation
        2) insurance
        3) interest
        4) computed building cost
        5) license

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[1] Reservations should be applied to this statement. First, equipment is only one of the many substitutable inputs. Therefore, dollar cost of equipment per unit output may be high in some cases because equipment has been substituted for other high priced inputs. Secondly, several different types of equipment may be designed to perform the same function and they may require amounts of other inputs.

d) variable costs
    1) computed net depreciation
    2) computed buildings cost
    3) fuel
    4) oil, grease, and antifreeze
    5) other
e) fuel consumption per hour or mile used
f) variable costs per hour or mile used
g) total costs per hour or mile used

Real Estate Accounts

There are many different types of real estate accounts and each should be handled differently. Therefore, in this section there will be several sub-sections describing the costs and returns and methods of summary of the different accounts.

Dwellings Accounts

Dwellings accounts are designed to keep records on the operators' houses, tenant houses and labor camps. In the past the operator's house has generally been considered part of the farm real estate with ownership tied to the ownership of the farm. However, particularly in recent years some farmers have built homes that are much more than a home for a farm worker. That is, differences exist among farmers and their families with reference to the amount of money spent on their homes and often much of this expenditure is in the nature of consumer goods. Also, some farm partnerships are being organized with the house excluded from the business assets and with all associated expenses, including taxes, being excluded from the business expenses. Therefore, the operator's house usually can best be considered a personal investment rather than a farm investment. The wage rate paid to the farmer in such cases should reflect the fact that the farm business does not furnish the privilege of housing to the farm operator. Since the operator's house usually is considered as part of his personal possessions, no analysis is made of the enterprise.

In some cases the operator's house can be considered a farm investment. If this is the case, then the operator's house account should be handled in the same manner as the tenant houses. The wage paid to the farmer would be less than in the case where the house is a personal investment.

The tenant houses should be considered farm investments even though they are not essential to the operation of the farm. The account should be handled as though one of the enterprises on the farm was the rental of houses. The farmer could rent the houses to farm workers or others or could furnish them rent-free to his workers. The rental fee which the possible renters would be willing to pay should be the value to the farm employee. In reality the employee's wage rate is usually reduced and no rental is charged for the house. Therefore, if the tenant house is used by farm employees, it is appropriate to credit the enterprise with the supposed rental fee and debit the appropriate labor account an equal amount as a farm privilege. In some instances the farmer actually receives cash rentals from tenant houses. These are credits to the tenant house account.

Labor camps are found on some New York farms, primarily in fruit areas. These camps supply housing for migrant workers used in the growing and harvesting of crops. The camps are rarely rented as dwellings to non-farm employees and, thus, rental figures are not obtainable. Therefore, a different approach must be taken. If the farmer did not house migrant workers on his farm he would have two other alternatives. The first would be to rent housing for them from another source. The second would be to pay a higher wage and let the workers supply their own housing needs. In either case, the additional outlay of money which the farmer would have to pay establishes an opportunity cost value which can be credited to the labor camp and debited to the labor accounts making use of the camp.

In all cases it should be noted that a positive effort is made to obtain rental values for dwellings accounts and these values are variable cost inputs to the labor accounts. All dwellings accounts should be closed with loss or gain entries.

Farm Buildings

Number of Buildings Accounts Needed. In recent years farm buildings have become increasingly specialized in functional design.[1] Previously the farm buildings were fairly homogeneous in design and use. They could be aggregated into few accounts. But with specialized buildings it is possible to get increased accuracy of allocating buildings costs with more separate accounts. Thus, a separate building account is needed for each group of special use buildings.

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[1] Special barns are now being built to house each different type of livestock rather than general purpose barns for all types of livestock.

Debits and Credits of Building Accounts. As is the case in the equipment accounts, there is rather limited rental or leasing of farm buildings and, therefore, the accounts should be closed at cost. This necessitates the splitting of the costs into fixed and variable categories.

As with equipment, one of the major problems in arriving at fixed and variable costs is the separation of fixed and variable gross depreciation. Unlike equipment, it is nearly impossible to obtain data from the buildings accounts to enable separation by a statistical computation, thus another approach is needed. The best available alternative is subjective judgment.

To get such an estimate nine individuals familiar with the problem were approached. Although there was variation in their estimate of percentage of the gross building depreciation that is variable, the average was 18 percent. This is a relatively small percentage of the gross depreciation. However, it appears logical considering the long-term nature and quality of construction of most buildings.

The formulas used in computing fixed and variable gross depreciation are shown below:

1) $D_T = I_B - I_E + R$

2) $D_V = rD_T$

3) $D_F = (1-r)\ D_T$

where

D_F = fixed gross depreciation

D_V = variable gross depreciation

D_T = total gross depreciation

I_B = beginning inventory (market value)

I_E = ending inventory (market value)

R = repairs (including materials, labor and equipment)

r = proportion of total gross depreciation that is believed accountable to use. (The recommended percentage figure to be used is 0.18. This is the average figure obtained in the survey discussed above.)

The gross depreciation figures should be combined with other costs of the building account to obtain total, fixed, and variable cost figures. (Table 3).

Table 3. BUILDING ACCOUNTS I

Debits			Credits			
Fixed Costs		$6000	Fixed Costs Charge Out			$6000
Gross Dep.*	$4100		Loss	10%	$ 600	
Taxes	325		Enterprise A	72%	4300	
Insurance	395		Enterprise B	9%	540	
Interest**	1180		Enterprise C	9%	540	
Variable Costs		900	Variable Costs Charge Out			900
Gross Dep.*	900		Enterprise A	80%	720	
			Enterprise B	10%	90	
			Enterpaise C	10%	90	
Total Debits		$6900	Total Credits			$6900

* Computed

** Present interest rate multiplied by average inventory value

The similarity between the equipment and building accounts does not cease with the debits of the accounts. In most cases the credits are handled in the same manner. With few exceptions (e.g., storage structures on the farm), it is difficult to rent or lease farm buildings. Therefore, the alternative, as in the case of the equipment accounts, is to close the account at cost. The fixed and variable costs should be allocated to the enterprise making use of the buildings on a subjective basis by the farm operator.

Among the factors the farmer should consider in arriving at his subjective proportions are the proportion of the total space used and damage contributed by each enterprise. The reasoning behind these is intuitively obvious, but they should not be the only factors considered.

The operator should also consider the market value of the item or product making use of the building. For example, if the farmer has built a general purpose storage structure designed to store safely both a high and a low value product, the low value product should be charged a lower proportion of the building's costs. The reason is that a more expensive storage structure was built to store both than was needed to store the low value product alone.

A final consideration to be used in setting the proportions for closing out the account is the number of alternative uses of the building. A building may be only partly utilized by an enterprise and there may be no other alternative enterprises that can utilize the remaining building space. Therefore, it can be argued that this enterprise should not be charged with the full amount of the fixed costs, and that a proportion of these costs which corresponds to the unused building space can reasonably be charged to the loss account.

The formula for use in figuring the credits to the building account and thus debits to enterprises using the building is as follows:

$$TC = (FC \cdot P_L) + \sum_{X=1}^{n} ((VC \cdot P_X) + ((FC - (FC \cdot P_L)) \cdot P_X))$$

where

TC = Total credits of building enterprise

VC = Total variable cost of building enterprise

FC = Total fixed cost of building enterprise

P_X = Proportion of cost to be allocated to enterprise X

P_L = Proportion of building fixed costs that should be charged to the loss account because building was used less than normally

n = Number of enterprises using building

Farm Improvements

Included in farm improvements are such items as drainage systems, fencing, ponds and roadways. The costs associated with improvements are shown in Table 4. Again there is not a market value for the services of these accounts and, therefore, they should be closed at cost. However, the closing differs from that of the equipment and building accounts in that no distinction should be made between fixed and variable costs. The costs for these accounts are small and for purposes of simplification they should be closed as though the costs were all variable. Many of these accounts should be closed to other service accounts in which they are handled in such a manner as not to be concerned with fixed and variable costs.

Table 4. IMPROVEMENTS ACCOUNTS I

Debits		Credits		
Net Dep.*	$170	Enterprise A	60%	$210
Repairs and additions**	80	Enterprise B	30%	105
Interest***	55	Enterprise C	10%	35
Taxes	20			
Insurance	25			
Total Debits	$350	Total Credits		$350

* Beginning inventory minus ending inventory
** Includes materials and labor
*** Present interest rate multiplied by average inventory value

For the farm improvement enterprises the farmer should establish subjective percentages to be used in closing the costs. The decision of which enterprises are to be charged with the costs depends upon the specific improvement account. Fences, in most cases, should be divided between the various land accounts rather than the livestock accounts. Fences are generally built not only to retain animals to a grazing or feeding area but to keep them out of crops. However, there are cases (e.g., feed lot operations) in which the costs of fencing should be charged directly to the livestock accounts.

Drains costs should be charged directly to cropland or orchards; water systems costs should be charged to the enterprises making extensive use of the water. Ponds costs should be charged to livestock using the pond as a water source and to buildings for fire fighting.

Other farm improvement accounts can be handled as the particular circumstances indicate are best.

Cropland, Pasture, Orchard and Vineyard Accounts

Number of Accounts Needed. The number of accounts needed for enterprises such as cropland, pasture, orchards and vineyards is dependent upon the type of account. For example, if the farm has fairly homogeneous land and pasture resources, then one cropland and pasture account is sufficient. But if the farm has two or more distinct cropland types, more cropland accounts are needed to simplify the accounting and make the allocation of costs more accurate. The orchard accounts will generally be greater in number. An orchard account is needed for each type of orchard (e.g., apple, pear, etc.). The number of vineyard accounts will be similar to the cropland needs. The farmer may wish separate accounts for his wine grapes, juice grapes and his fresh market grapes, particularly if sizable differences in costs per acre exist.

Cropland, Pasture, Orchard and Vineyard Accounts. The costs and returns for enterprises such as cropland, pasture, orchard and vineyards are shown in Table 5. There are both fixed and variable costs on the debit side of the account. However, the costs are not divided into these two groups because the allocations are based on rental rates.

Table 5. LAND ACCOUNT I

Debits		Credits		
Net Depreciation*	$ - 1000	Enterprise A****	100 acres	$1200
Repairs** and additions	200	Enterprise B	75 acres	750
Interest***	1800	Enterprise C	15 acres	150
Taxes	900	Enterprise D	10 acres	100
Improvements	40	Total acres	200	
Insurance	10			
Gain	250			
Total Debits	$ 2200	Total Credits		$2200

* Beginning inventory minus ending inventory

** Includes materials and labor

*** Present interest rate multiplied by average inventory value

**** Rental fee established by farmer was 12 dollars per acre for all enterprises using land resource.

Although it is difficult for some farmers to obtain reasonable rental fees because they neither rent-in or rent-out land, most of the cost account cooperators do rent land and know what these rates should be. These should be used in making allocations and the accounts should be closed with loss or gain entries.

Non-Bearing Orchards and Vineyards and New Buildings Accounts

A farmer's activities may involve development enterprises which may be long-run for the non-bearing orchards and vineyards and short-run for buildings. In the accumulation of costs a separate account is needed for each developing orchard, vineyard and new building. Table 6 illustrates the debits and credits of a non-bearing orchard (or vineyard) account. The costs should be categorized as fixed and variable and the account should be balanced by including the total cost at the end of the accounting period in the ending inventory. When the non-bearing orchard or vineyard reaches bearing age, then the account should be "sold" to the bearing orchard or vineyard account at the present market price and the account can then be balanced with a loss or gain entry.

Table 6. NON-BEARING ORCHARD ACCOUNT I

Debits			Credits	
Beginning Inventory		$15,600	Ending Inventory	$18,530
Fixed Costs for Year		2,100		
Tractor*	$100			
Equipment*	250			
Interest**	936			
Insurance	64			
Taxes	750			
Variable Costs for Year		830		
Tractor*	50			
Equipment*	130			
Labor	370			
Fertilizer	60			
Spray	120			
Manure	10			
Lime	25			
Improvements	8			
Interest***	47			
Other	10			
Total Debits		$18,530	Total Credits	$18,530

* These are computed costs
** Present interest rate multiplied by beginning inventory value
*** Present interest rate multiplied by 1/2 variable costs for year

It can be argued that the loss or gain existing after this long development period should not be taken in the final period but should be spread over all the years in the development process. This is a reasonable argument but it is not possible to predict whether there will be a profit or loss nor the total amount that will be incurred in the development process. Also, few partically grown orchards or vineyards or partically finished buildings are sold. Consequently, values for these are difficult to obtain. Then too, if there is continual development and replacement or adding of orchards, the total gain (or loss) of one development orchard should approximate the partial gains (or losses) of several.

The handling of the costs of a new building account should be identical to that of the non-bearing orchard or vineyard account. However, the credits of the account differ in that when the building is finished the account is closed at cost to the buildings accounts. At first it would seem that a consistent policy ought to be followed. However, most farmers in constructing new buildings, recognize that there is no ready market for them and also that they will not add the full cost to the value of the farm when they are completed. The costs are, therefore, incurred with the anticipation of their being recovered through savings elsewhere. This can be done by inventorying the new building at cost and recovering the cost in the form of depreciation.

Woods and Other Real Estate-Production Accounts[1]

These are unique accounts in that they are both overhead and production accounts. The costs associated with the overhead of these accounts are combined with the production costs (Table 7).

Table 7. WOODS ACCOUNT I

Debits		Credits	
Beginning Inventory	$ 700	Ending Inventory	$ 600
Labor Costs	50	Product Sales	450
Power and Equipment Costs	20		
Interest*	90		
Supplies Costs	10		
Taxes	30		
Other Costs	20		
Gain	130		
Total Debits	$1,050	Total Credits	$1,050

* Present interest rate multiplied by average inventory value

[1] Another example of such an account is gravel.

The credits of the accounts are ending inventory and products sales. The account can be closed to the loss and gain account.

Rented Real Estate

The rental of additional real estate to increase the size of a farm operation is a common practice among New York farmers and provision is needed in the cost accounting system. To fill the need special rented real estate accounts can be used to record as debits the rental fee which is a variable cost.

Because the property which is rented may include different types of land and even buildings, the allocation of the costs may be difficult. A subjective basis can be used to divide the rental fee between the different types of real estate rented. Once this initial step has been accomplished, the allocation of the parts can be fairly simple. The parts associated with the lands should be charged on a per acre ratio to the enterprises using the land and those for the buildings should be allocated on a subjective basis to the enterprise making use of the buildings. In all cases the rented real estate costs are variable costs to the using enterprise.

CHAPTER VII

FARM COST ACCOUNTING FINANCIAL RECORDS; ALLOCATION ACCOUNTS

The allocation accounts are mainly convenience or simplifying accounts used to accumulate costs over the accounting period. When the financial records are closed, these expenses should be transferred to the enterprises for which the costs were incurred. For example, a farmer buys bulk fertilizer and applies it to several crops. It is easier for him to put the fertilizer payment (or payments) in an allocation account and at the end of the year make the transfers necessary to close the account rather than assign each payment as it is made.

The number of allocation accounts needed will depend upon the farm operation. Some farms require only a few common allocation accounts while others have need for several. The degree of specialization of the farm has an effect on the need for such accounts.

Electricity and Telephone Accounts

The basis for closing of the electricity and telephone accounts is decided subjectively by the farmer. He can make a good estimate of what enterprises are the larger users of these services and thus charge them with the major proportion of the cost. Enterprises that are minor users of these services may be overlooked in allocating costs but the amount of bias introduced will be small.

Taxes Accounts

Property Taxes of the farm are dependent upon the assessed value of the farm real estate. Since the total assessment of the farm is the summation of the real estate parts, it is logical to use a formula based on inventory values for the allocation of the taxes to the appropriate real estate accounts. (See the formula below.)

$$TC = \sum_{X=1}^{n} \left(T \cdot \left(V_X \Big/ \left(\sum_{X=1}^{n} V_X\right)\right)\right)$$

where

- TC = Total credits of taxes account
- T = Total taxes of taxes account
- V_X = Average inventory value of real estate account X except of new buildings and non-bearing orchard and vineyard for which the beginning inventory value is used
- n = Number of real estate accounts

Fire Insurance Accounts

When an insurance policy is written it specifies the coverage and amount. Because of this it should not be difficult to transfer the insurance cost. However, it often becomes troublesome because the policies are complicated by riders and refunds on certain items. To deal with these complications the following formula may be used to allocate the cost:

$$TC = \sum_{X=1}^{n} (I \cdot (V_X / (\sum_{X=1}^{n} V_X)))$$

where

TC = Total credits of fire insurance account

I = Total net fire insurance cost

V_X = Average inventory value of item covered

n = Number of covered items

General Expense and Income Accounts

Included in this account should be such items as business travel, magazine and paper subscriptions, farm awards, and cash discounts and rebates. The account could be closed to the loss and gain account; or the difference between the debits and credits can be allocated on a subjective basis to the major farm enterprises. The latter alternative is consistent with the remainder of the cost account system with only accounts having opportunity costs being closed to the loss and gain account.

Lime Accounts

The lime account could be handled like the fertilizer allocation account if the effect of liming were not spread over a period of years. (10:15-16) The lime cost thus has the nature of a short-term capital investment. Because of this, lime applied on the fields should be carried in inventory over a few years until the effect of the liming has nearly diminished. The exact amount of time during which liming has an effect is dependent upon a number of factors including soil type, weather, crops grown, original soil pH level, quality of limestone, etc. (10:15-16) However, a uniform method for all cost account farms can be to allocate the lime cost equally over a three year period to the crops grown on the fields on which the lime was applied.

Manure Accounts

Before the advent of readily available commercial fertilizers, the handling and use of manure was considered an important part of managing a farm. But modern agriculture has changed manure from an asset to a liability on many farms. Commercial fertilizers are effective and flexible substitutes for manure. Therefore, a new method of handling the manure account is in order.

The costs of the manure account include the cost of application of the manure to the fields. The returns of the manure account are dependent upon the nutrient value of the manure and the price of the commercial fertilizer. This nutrient value is in turn dependent upon the manure type, method of handling, composition of the manure, and crops on which applied. Based on the recent agronomic field crop recommendations, one ton of manure applied on its best alternative use is about equal to the equivalent of four pounds of nitrogen and has a limited carry-over effect from year to year. (10:17-20) The equivalent price of commercial nitrogen establishes the returns of the manure account and the cost to the crop upon which it was applied. Both the costs and returns are transferred back to the manure producing enterprises by the following formula:

$$T_X = ME_X \,/\, \left(\sum_{X=1}^{n} ME_X \right)$$

where

T_X = Costs or return transfer to enterprise X

ME_X = Number of manure equivalents produced by enterprise X

n = Number of manure producing enterprises

Feeds and Supplies Accounts

A number of allocation accounts in this general heading include feeds, spray materials, fertilizer, containers, fuel, oil, grease, general equipment repairs, and general building repairs.

A number of means can be employed in transferring the costs of these to the appropriate accounts. The farmer can record the usage of items for these accounts in the supplemental physical data record or on special purpose recording forms. If the usage rate for the enterprises is fairly constant, then the farmer's memory is often sufficient for allocating the cost. Finally, formula closing of some accounts may be the most desirable. Such a case exists in the general equipment repairs account. The account should be closed to the equipment enterprises on the basis of the proportion the average inventory value of the equipment in a particular equipment account is to the total average inventory value of all equipment.

CHAPTER VIII

FARM COST ACCOUNTING FINANCIAL RECORDS; PRODUCTION AND MISCELLANEOUS ACCOUNTS

Production Accounts

The production Accounts are designed to record information on the production of farm commodities. It is the summarization and analysis of these accounts that is of primary interest to the farmer, researcher, and educator. The production and sale of these commodities is the main source of income for the farm. Therefore, it is important to know which commodities are most profitable. Because of this, one of the main purposes in analyzing these accounts will be to derive costs and returns figures. In addition, a number of analysis factors should be computed. Some of the more common analysis factors computed from the production accounts include input-output coefficients per productive unit, number of productive units in enterprises, cost and returns per unit of output, returns per hour of labor, and returns per dollar of total variable cost.

The input-output coefficients per productive unit are important in indicating strong and weak points in the enterprise. Unusual coefficient values should indicate to the farmer areas of weak or strong management. The researcher in an investigation of coefficients can discover which areas of management have the greatest effect on profit. Also, the researcher can observe the effect of new technology via the coefficients and thus make recommendations as to the potential of the technology.

The number of productive units within the enterprise is a size indicator. The size of an enterprise is an important part of management because of economies and dis-economies of scale. A farmer may learn that some of his expenses are high because of his relatively small scale of operation. Likewise, a farmer may learn that certain expenses of his operation are unusually high because of over-expansion of the enterprise.

Cost and returns per unit of output are important in cost control and enterprise selection. If a farmer notes that an enterprise is not profitable, he has two alternatives which will enable him to increase the profits or reduce the losses. First, if the enterprise is covering all variable costs and contributing toward the payment of the fixed costs, he can increase the intensity of the enterprise so that more units of output are available to absorb the fixed costs. Secondly, if the enterprise is not covering the variable costs, the farmer can drop the enterprise or adapt new technology so that he may register a profit. If the farmer has profitable enterprises, then perhaps he should expand the size of these and at the same time increase the intensity. The researcher and educator can also use this information in making recommendations on which enterprises have promise of being profitable.

Returns per hour of labor before the advent of mechanized agriculture were important as an indicator of which enterprise would return the farmer, his family, and employees the most for the time and effort expended. The measure also enabled the comparison of the profitableness of unlike enterprises such as cows and apples. However, mechanization has reduced the labor input on some enterprises to such a low level that a small fluctuation in the amount of labor used or the level of profit greatly effects the returns per hour of labor. Therefore, its usefulness as an analysis factor is limited and its computation is mainly of historical significance.

Returns per dollar of total cost are an overall indicator of the profitableness of the enterprises. A percentage figure greater than one hundred indicates enterprises that are profitable and the greater the percentage figure, the more profitable is the enterprise. This percentage figure as well as returns per dollar of variable cost are important aids in allocating capital on farms where capital is a limited resource.

For the cost accounting project detailed analysis may not be made of all accounts. Because of the limited number of farmers involved in the project, there may be several enterprises that will appear only once or twice among all the farms. The average obtained would, therefore, have little value to the researcher. The accounts that should be analyzed in detail are those that are most important to New York agriculture. Importance may be defined by number of farms having the enterprise or amount of contribution to the gross agricultural receipts of New York State. For the individual farmer each productive activity should be analyzed. A disucssion of the enterprises on which detailed analyses were made follows.

Crops Accounts

The crops accounts should be divided into two parts, production and storing and selling. The division should be made because of the great variation in marketing done among farmers. Furthermore, the marketing functions performed by the farmer should also be subjected to profit or loss analysis. Also, the separation eliminates the problem of choosing between a sale price and a purchase price in selecting the cost figures for intra-farm transactions. For example, the dairy enterprises should pay the market price for delivered hay and the hay enterprises should be credited with a non-delivered price at the farm. The difference between the two prices is related to the marketing function of location.

The cost and returns of the crop production accounts are shown in Table 8. Note that the production of crops should be sub-divided into growing and harvesting costs. The reason for the division is related to the concept of fixed and variable costs. At harvest time all the growing costs are then fixed costs. The farmer, therefore, should only consider the variable costs and returns of harvesting in deciding whether or not to harvest the crop. This information is important to farmers producing crops with highly volatile prices such as is the case for sour cherries.

The analysis factors that may be computed from the crop production accounts are listed below:

1) Size of enterprise in acres
2) Analysis factors on a per acre basis
    a) yield
    b) total and variable costs to grow and harvest the crop and its by-products
    c) total and variable costs to grow the crop and its by-products
    d) total and variable costs to harvest the crop and its by-products
    e) total and net returns
    f) hours labor to grow and harvest
    g) returns to labor
3) Analysis factors on a per unit output basis
    a) total and variable costs to grow and harvest the crop and its by-products
    b) total and variable costs to grow the crop and its by-products
    c) total and variable costs to harvest the crop and its by-products
    d) total and net returns
    e) hours to grow and harvest
    f) returns to labor
4) Returns per dollar of total and variable costs
5) Total returns per hour labor

The value of the crop at harvest, a credit to the crops production account, becomes a debit to the crop storing and selling account if the crop were not sold at harvest (Table 9). Some of the other costs of storing and selling include building cost, equipment cost, and direct costs of selling such as packaging, grading and commissions. The returns to the accounts are sales or intra-farm income. The account should be balanced by closing entries to the loss and gain account.

There usually are no analysis factors computed on the crop storing and selling accounts. This is because of the variation in the amount of marketing functions performed among farms and the difficulty in making comparisons.

Some crops have growing costs spread over two or more accounting periods. Special provisions are made for these accounts so that the costs of one accounting period can be shifted to the accounting period in which the crop is harvested. In some cases (e.g., winter wheat), the harvest is only one accounting period forward. The method used to handle such cases is to carry all of the growing costs, grouped as shown in Table 8, forward to the next accounting period via the inventory. There are cases (e.g., hay seedings) in which several harvest years follow the year of seeding. In such cases only the total investment figure should be carried forward via the inventory and the cost should be allocated to the crops grown over the life of the investment.

Table 8. CROPS ACCOUNT I - 10 ACRES

Debits:				
Growing				$615
Fixed			$ 58	
Tractor*		$23		
Equipment* (truck included)		35		
Variable			557	
Tractor*	70 plow-hours**	38		
Equipment* (truck and auto included)		15		
Interest***		30		
Manure		15		
Fertilizer	N = 950 lbs. P = 500 lbs. K = 550 lbs.	196		
Seed	2.6 bu. (or seeding cost)	34		
Spray Materials		66		
Labor	24 hours	48		
Cropland	10 acres	110		
Other growing		5		
Harvesting				99
Fixed			23	
Tractor*		8		
Equipment* (truck included)		15		
Variable			76	
Tractor*	25 plow hours**	10		
Equipment* (truck and auto included)		7		
Hired harvesting		12		
Labor	20 hours	40		
Other harvest		7		
Gain				76
Total Debits				$790
Credits:				
Value of crop at harvest****	800 bu.			760
Value of by-product at harvest****				30
Total Credits				$790

* These are computed costs.

** Plow-tractor is defined as hours of tractor use multiplied by plow rating of tractor.

*** See bottom of Table 9 for formula used in figuring interest cost.

**** Includes products sold at harvest and transferred into the storing and selling account.

Table 9. CROP STORING AND SELLING ACCOUNT I

Debits:		
Fixed		$ 50
Equipment*	$ 20	
Tractor* and Truck*	10	
Buildings*	20	
Variable		1072
Beginning inventory of product	175	
Beginning inventory of by-product	25	
Value of crop at harvest	760	
Value of by-product at harvest	30	
Equipment*	8	
Tractor*, truck* and auto	12	
Buildings*	5	
Interest**	13	
Advertising	2	
Direct cost of selling	40	
Other	2	
Gain		92
Total Debits		$1214
Credits		
Ending inventory of product		$ 300
Ending inventory of by-product		50
Sale of product		810
Sale of by-product		54
Total Credits		$1214

* These are computed figures

** Interest costs were figured by the following formula:

$$I = \frac{M/2}{12} \cdot r \cdot V_C$$

where

I = Interest cost to enterprise

M = Months product was stored

r = Current rate of interest

V_C = Variable costs of storing and selling

Livestock Accounts

The livestock accounts are less standardized than the crops accounts. Unlike the former each type of livestock has its own special expenses, receipts, and analysis factors. Detailed consideration is only shown for three animal enterprises--dairy cows, dairy heifers, and laying hens. The less important livestock enterprises, such as beef, swine, chicks and mink should each be given a special account on the farms where they are found but no special effort may be made to group the costs, returns nor to calculate analysis factors.

Dairy Cows Accounts

Dairy cows accounts are viewed with keen interest because of the economic importance of milk production to New York agriculture. However, the accounts should be analyzed in the same manner used for other production accounts with the computation of cost, returns, and analysis factors. In Table 10 the costs and returns of the dairy cows enterprise can be found. The analysis factors which may be computed from the cow accounts are shown below:

1) Size of enterprise--average number of cows
2) Butterfat test
3) Average per cow
    a) pounds of butterfat
    b) hundred weight milk produced
    c) dollars of grain fed
    d) tons of hay fed
    e) tons of silage fed
    f) total feed and bedding cost
    g) depreciation
    h) total returns
    i) total and variable costs to maintain cows
    j) profit
    k) man hours
    l) labor returns
    m) average inventory value
4) Average per hundred weight of milk
    a) value
    b) fixed and variable costs
5) Total returns per hour of labor
6) Total returns per dollar of total and variable costs

Table 10. DAIRY COWS ACCOUNT I (120 Cows)

Debits:		
Fixed		$ 6,185
Equipment*	$ 2,690	
Buildings*	3,250	
Tractor* and truck*	245	
Variable		62,175
Equipment*	825	
Buildings*	715	
Tractor*, truck* and auto	495	
Grain	20,520	
Silage (Hay) 110 tons	1,100	
Silage (Corn) 1144 tons	10,925	
Pasture	935	
Bedding	565	
Depreciation**	3,320	
Labor 6600 hours	12,100	
Interest***	2,045	
Veterinarian and medicine	1,365	
Breeding costs	705	
Hired milk hauling	2,345	
DHIC	550	
Insurance	145	
Registrations and transfers	45	
Utilities	925	
Supplies	670	
Other	1,880	
Gain		6,235
Total Debits		$74,595
Credits:		
Milk sold 1,377,200 lbs.		$70,630
Milk used on farm 15,600 lbs.		750
Calves		2,660
Manure		490
Other		65
Total Credits		$74,595

* These are computed costs.

** Depreciation is defined as beginning inventory value less ending inventory value plus purchases minus sales.

*** Current interest rate multiplied by average inventory value of cows.

Dairy Heifer Accounts

The costs of dairy heifers are similar to those of the dairy cows accounts. The returns of the account are the sale, either internal or external of the farm business, of mature dairy heifers (Table 11). The analysis factors of the dairy heifer accounts are listed below:

1) Size indicator--average number of heifers
2) Number of heifers months[1]
3) Number of heifer equivalents[2]
4) Averages per heifer equivalent
    a) Total and variable costs
    b) Total returns
5) Averages per mature heifer sold or transferred to the cow account
    a) Total and variable costs
    b) Value of sold or transferred heifers
    c) Total returns
    d) Cost of calves
    e) Cost of feed and bedding
    f) Hours of labor
6) Total returns per hour labor
7) Returns per dollar total and variable cost

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[1]A heifer month may be defined as the keeping of one heifer for one month.

[2]Heifer equivalent is defined as the average number of heifer months required from birth to the time the heifer freshens. This figure can be obtained from the DHIC records. The heifer equivalent figures are used in standardizing costs and returns among heifer accounts.

Table 11. DAIRY HEIFERS ACCOUNTS I (80 Matured Heifers)

Debits:		
Fixed		$ 1,875
Equipment*	$ 245	
Tractor* and truck*	55	
Buildings*	1,575	
Variable		50,223
Beginning Inventory	26,000	
Equipment*	85	
Tractor*, truck* and auto	65	
Buildings*	345	
Calves 42 started	1,638	
Milk and milk substitutes	1,368	
Grain	3,808	
Hay 184 tons	4,795	
Silage (Hay) 8 tons	115	
Silage (Corn) 320 tons	3,144	
Pasture	1,625	
Bedding	395	
Labor 208 hours	3,650	
Breeding fees	295	
Veterinarian and medicine	15	
Insurance	95	
Registration and transfers	105	
Utilities	315	
Interest**	1,560	
Other	805	
Total Debits		$52,098
Credits:		
Ending Inventory		$26,000
Heifers sold 80		25,580
Manure		240
Other		30
Loss		248
Total Credits		$52,098

* These are computed costs.

** Current rate of interest multiplied by average inventory value.

Laying Hens Accounts

Another major livestock enterprise in New York State is laying hens. The method used to summarize the costs and returns to these accounts is shown in Table 12.

A number of analysis factors can be computed from the hens accounts financial records. The listing of these analysis factors is as follows:

1) Size indicator--average number of hens in account
2) Mortality rate
3) Average per 100 birds
    a) Total and variable costs
    b) Dollars of grain fed
    c) Hours of labor
    d) Depreciation
    e) Returns
    f) Profit
    g) Labor returns
4) Averages per dozen eggs
    a) Total and variable costs
    b) Returns
5) Total returns per hour of labor
6) Returns per dollar of total and variable cost

Miscellaneous Accounts

Included within this classification of accounts are the personal, net worth, interest, cash, accounts payable and receivable, non-farm investment and loss and gain accounts. The function of these accounts is to complete the accounts system. They are necessary in making the accounts balance in a double-entry accounting system. Because they are only balancing accounts, no analysis should be made of them.

Table 12. LAYING HENS ACCOUNT (20,000 birds)

Debits:		
Fixed		$ 7,353
Equipment*	$ 2,485	
Tractor* and truck*	440	
Buildings*	4,428	
Variable		125,450
Equipment*	615	
Tractor*, truck* and auto	565	
Buildings*	975	
Depreciation**	24,860	
Feed 1,963 pounds	70,200	
Grit, shell and minerals	615	
Litter	225	
Labor 1,237 hours	21,265	
Interest***	1,020	
Utilities	1,435	
Other	3,675	
Gain		33,787
Total Debits		$136,590
Credits:		
Eggs sold 37,113 dozen		$136,050
Eggs used		85
Manure		415
Other		40
Total Credits		$136,590

* These are computed costs.
** Beginning inventory less ending inventory plus purchases minus sales.
*** Current rate of interest multiplied by average inventory value.

CHAPTER IX

ADDITIONAL USES OF COST ACCOUNTING DATA

The cost accounting data can be used for other purposes than those pertaining directly to the analysis of the financial records. In fact, there are only minor advantages of using electronic data processing equipment to handle cost accounting records if no additional uses of the data are made. The suggestions of alternative uses of data which follow are by no means exhaustive and the total number of uses is only dependent upon the nature of the data and the researcher's ability and desire to adapt the data to his needs.

Linear Programming Models

A linear programming model must have three characteristics in order to reach a maximizing (minimizing) solution. These three characteristics are as follows: "1) an objective function that can be quantified as in dollars of profit or cost, amount of physical input or output, etc.; 2) alternative ways or processes of attaining this objective; and 3) restrictions which limit the kinds and amounts of processes or alternatives that can be used in attaining this objective." (6:11)

Cost accounting records can serve in connection with these three characteristics. This point can be illustrated by means of a hypothetical example. Assume that extension agents from a segment of New York State and a researcher agreed that it was desirable to develop a flexible linear programming model. This model was to be used on individual farms to aid farmers in the making of profit oriented decisions. The model was designed for dairy-crop farms. Dairy enterprises included in the model were the milk production and the raising of dairy replacements. Only those crops considered by the extension agents and researcher to be economically relevant were incorporated into the model. Various types of labor, power and equipment, storage facilities and land types were determined to be the major fixed resources on the farms. With these considerations in mind the following model was developed:

Objective function:

$$\begin{aligned} \text{Maximize } Z = {} & 319P_1 + 140P_2 - 55P_3 + 16P_4 - 60P_5 + 30P_6 - 40P_7 \\ & - 38P_8 - 36P_9 - 34P_{10} + 64P_{11} + 430P_{12} - 35P_{13} + 30P_{14} \\ & - 325P_{15} + 300P_{16} - 0.8P_{19} - C_{24} \cdot P_{24} - C_{25} \cdot P_{25} \\ & - C_{26} \cdot P_{26} - C_{27} \cdot P_{27} - C_{28} \cdot P_{28} - C_{29} \cdot P_{29} + C_{30} \\ & \cdot P_{30} - C_{31} \cdot P_{31} \end{aligned}$$

Restrictions:

$$S_1 \geq 1P_1 + 0.25P_2 + 2P_3 + 1.5P_4 + 2P_5 + 1.5P_6 + 3P_7 + 3P_8 + 3P_9 + 3P_{10} + 4P_{11} + 15P_{12} + 1P_{20}$$

$$S_2 \geq 1P_1 + .25P_2 + 1P_{21}$$

$$S_3 \geq 1.5P_1 + 0.4P_2 + 5P_2 + 2P_4 + 4.5P_5 + 1.7P_6 + 5P_7 + 3.2P_8 + 4.4P_9 + 2.7P_{10} + 4P_{11} + 12P_{12} - 1P_{20} + 1P_{22} - 1P_{24}$$

$$S_4 \geq 1.5P_1 + 0.4P_2 - 1P_{21} + 1P_{23} - 1P_{25}$$

$$S_5 \geq 0.5P_1 + 0.6P_2 + 0.8P_8 + 0.8P_{10} + 30P_{12} - 1P_{22} - 1P_{26}$$

$$S_6 \geq 0.5P_1 + 0.6P_2 - 1P_{23} - 1P_{27}$$

$$S_7 \geq 0.5P_1 + 0.2P_2 + 20P_3 + 11P_4 + 18P_5 + 10P_6 + 15P_7 + 12P_8 + 13.5P_9 + 11P_{10} + 24P_{11} + 90P_{12}$$

$$S_8 \geq 0.5P_1 + 0.2P_2$$

$$S_9 \geq 1P_2 - 1P_{17}$$

$$S_{10} \geq 160P_4 + 120P_6 - 1P_{19}$$

$$S_{11} \geq 15P_3 + 12P_5 + 6P_7 + 4P_9$$

$$S_{12} \geq 3P_8 + 2P_{10}$$

$$S_{13} \geq 6P_1 + 3P_2 - 5P_3 - 4P_5 - 3P_7 - 3P_8 - 2P_{10} - 1P_{13} + 1P_{14} + 1.5P_{18}$$

$$S_{14} \geq -3P_8 - 2P_{10} - 1P_{13} + 1P_{14}$$

$$S_{15} \geq 0.25P_1 - 1P_2 - 1P_{15} + 1P_{16}$$

$$S_{16} \geq 1P_1 + 1P_{17}$$

$$S_{17} \geq 1P_3 + 1P_4 + 1P_7 + 1P_8 + 1P_{11} + 1P_{12} + 1P_{28} - 1P_{29}$$

$$S_{18} \geq 1P_5 + 1P_6 + 1P_9 + 1P_{10} + 1P_{20} - 1P_{30}$$

$$S_{19} \geq 1P_{18}$$

$$S_{20} \geq 1P_{11}$$

$$S_{21} \geq 1P_3 + 1P_4 + 1P_5 + 1P_6$$

$$S_{22} \geq 1P_7 + 1P_8 + 1P_9 + 1P_{10}$$

$$S_{23} \geqslant {}^{1}P_{11}$$

$$S_{24} \geqslant {}^{1}P_{24}$$

$$S_{25} \geqslant {}^{1}P_{25}$$

$$S_{26} \geqslant {}^{1}P_{26}$$

$$S_{27} \geqslant {}^{1}P_{27}$$

$$S_{28} \geqslant {}^{1}P_{28}$$

$$S_{29} \geqslant {}^{1}P_{29}$$

$$S_{30} \geqslant {}^{1}P_{30}$$

$$S_{31} \geqslant {}^{1}P_{31}$$

Where Z is dollars of profit of farm

P_1 is the cow activity (process)

P_2 is the heifer activity

P_3 is the corn silage activity on Class 1 and 2 land

P_4 is the corn for grain activity on Class 1 and 2 land

P_5 is the corn silage activity on Class 3 and 4 land

P_6 is the corn for grain activity on Class 3 and 4 land

P_7 is the hay silage activity on Class 1 and 2 land

P_8 is the baled hay activity on Class 1 and 2 land

P_9 is the hay silage activity on Class 3 and 4 land

P_{10} is the baled hay activity on Class 3 and 4 land

P_{11} is the dry beans activity. It is assumed that the beans will be sold at harvest or the farm has adequate storage facilities for dry beans.

P_{12} Is the potato activity. It is assumed that the potatoes will be sold at harvest or the farm has adequate storage facilities for potatoes.

P_{13} is the hay buying activity. This activity can purchase additional hay needed for the feeding of livestock when the farm does not produce the necessary amount.

P_{14} is the hay selling activity. In this activity baled hay that is not fed on the farm can be sold.

P_{15} is the heifer replacement buying activity. The activity is used to supplement the heifer activity when the farm does not raise enough replacements.

P_{16} is the heifer selling activity. It is through this activity that dairy heifers can be sold.

P_{17} is the barn transfer activity. Barn capacity not used by the cow activity can be used by the heifer activity.

P_{18} is the pasture activity.

P_{19} is the purchase of additional corn storage capacity.

$P_{20} - P_{23}$ are labor transfer activities. Type 1 labor (management labor) can be substituted for Type 2 labor (skilled labor). Also, Type 1 and 2 labor can be substituted for Type 3 labor (unskilled labor).

$P_{24} - P_{27}$ are additional Type 2 and 3 labor purchase activities. Through these activities the fixed labor supply can be supplemented.

$P_{28} - P_{31}$ are land rental activities. P_{28} is rent-out and P_{29} is rent-in of Class 1 and 2 land. P_{30} is rent-out and P_{31} is rent-in of Class 3 and 4 land.

S_1 is the number of hours of Type 1 labor available in the summer from the regular labor force on the farm.

S_2 is the number of hours of Type 1 labor available in the winter from the regular labor force on the farm.

S_3 is the number of hours of Type 2 labor available in the summer from the regular labor force on the farm.

S_4 is the number of hours of Type 2 labor available in the winter from the regular labor force on the farm.

S_5 is the number of hours of Type 3 labor available in the summer from the regular labor force on the farm.

S_6 is the number of hours of Type 3 labor available in the winter from the regular labor force on the farm.

S_7 is the number of tractor plow-hours of the farm available for use in the summer.

S_8 is the number of tractor plow-hours of the farm available for use in the winter.

S_9 is the capacity (number) of the heifer barns.

S_{10} is the capacity (bushels) of the corn cribs.

S_{11} is the capacity (tons) of the silos.

S_{12} is the capacity (tons) on the farm for storage of baled hay.

S_{13} is used to force the model to produce or buy enough hay equivalents to feed the livestock.

S_{14} is used to prevent more baled hay from being sold than the difference between production and farm utilization.

S_{15} is used to force the purchase or raising of enough dairy replacements to meet the requirements of the cow activity.

S_{16} is the capacity (number) of the cow barns.

S_{17} is the amount (acres) of Class 1 and 2 land on the farm.

S_{18} is the amount (acres) of Class 3 and 4 land on the farm.

S_{19} is the amount (acres) of pasture on the farm.

S_{20} is the capacity (acres) of the bean producing equipment.

S_{21} is the capacity (acres) of the corn producing equipment.

S_{22} is the capacity (acres) of the hay producing equipment.

S_{23} is the capacity (acres) of the potato producing equipment.

S_{24} is the additional number of hours of Type 2 summer labor that can be acquired at price C_{24}.

S_{25} is the additional number of hours of Type 2 winter labor that can be acquired at price C_{25}.

S_{26} is the additional number of hours of Type 3 summer labor that can be acquired at price C_{26}.

S_{27} is the additional number of hours of Type 3 winter labor that can be acquired at price C_{27}.

S_{28} is the number of acres of Class 1 and 2 land that can be rented-out at price C_{28}.

S_{29} is the number of acres of Class 1 and 2 land that can be rented-in at price C_{29}.

S_{30} is the number of acres of Class 3 and 4 land that can be rented-out at price C_{30}.

S_{31} is the number of acres of Class 1 and 2 land that can be rented-in at price C_{31}.

C_{24} is the cost (dollars per hour) of obtaining additional Type 1 summer labor.

C_{25} is the cost (dollars per hour) of obtaining additional Type 1 winter labor.

C_{26} is the cost (dollars per hour) of obtaining additional Type 2 summer labor.

C_{27} is the cost (dollars per hour) of obtaining additional Type 2 winter labor.

C_{29} is the rental fee that would be paid to rent-in additional Class 1 and 2 land.

C_{30} is the rental fee that can be obtained by renting-out Class 3 and 4 land of the farm.

C_{31} is the rental fee that would be paid to rent-in additional Class 3 and 4 land.

An examination of the cow activity will illustrate how use was made of averaged data from the cost account farms in the acre for which the model was developed. In Table 13 the data requirements of the cow activity are shown. By comparing Table 13 with Table 10 the usefulness of cost accounting data can be noted. For example, the returns over variable costs figure--a figure used in the objective function--was derived by using selected costs and returns from Table 10. Likewise, the physical requirement of the fixed resources or restrictions of the model was also determined from cost accounting data. The number of hay equivalents needed and the replacement rate was obtained from the financial record. The seasonal distribution of plow-hours of tractors usage and hours of labor was obtained from the supplemental physical data records.[1]

In a manner similar to that used in the cow activity, cost accounting data was used in the design of the other production activities. However, cost accounting data were of little value in establishing the initial level of the restrictions. These levels were to be collected on the individual farms. The variations which exist among the farms will account for different solutions from the model.

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[1]The model as defined assumes three different types of labor. It may have been necessary to ask the cost accounting farmers in the area to keep additional labor accounts during the development of the model in order to obtain data needed by the model. For simplicity of illustration, the usage of labor and tractor was divided into only two groups, winter and summer. However, a more detailed seasonal distribution can be obtained from the supplemental physical data records.

Table 13. THE DATA REQUIREMENTS OF COW ACTIVITY IN A HYPOTHETICAL LINEAR PROGRAMMING MODEL

Variable costs* per cow:		
Equipment		$ 7
Building	1 unit capacity	6
Tractor:		
Summer usage	.5 hours	1
Winter usage	.5 hours	1
Truck and auto		1
Grain		170
Bedding		3
Depreciation**		25
Interest		16
Veterinarian and medicine		11
Breeding costs		7
Hired milk hauling		19
DHIC		5
Insurance		1
Registrations and transfers		1
Utilities		8
Supplies		6
Other		16
Total variable costs per cow		$304
Returns per cow:		
Milk		$596
Calves		25
Manure		1
Other		1
Total returns per cow		$623
Returns over variable costs:		$319
Additional inputs of cow activity:		
Type 1 summer labor		1 hour
Type 1 winter labor		1 hour
Type 2 summer labor		1.5 hours
Type 2 winter labor		1.5 hours
Type 3 summer labor		0.5 hours
Type 3 winter labor		0.5 hours
Number of hay equivalents of feed		6
Number of dairy replacements		0.25

* Variable costs of the cow activity as defined by the model.

** The cost of replacement has been removed from the depreciation cost.

In recent years there has been some desire among farmers in applying a specific linear programming model to their farms. If a farmer has such a desire, it would be advisable for him to keep cost accounting records preceding the application of the specific model because cost accounting will supply more of the needed data for the model than other accounting systems. However, when a farmer keeps cost accounting records for the expressed purpose of obtaining data for a linear programming model, it may require that more accounts be kept (e.g., several separate labor accounts for different management abilities or skills) than would be needed for just cost accounting purposes.

In summary, cost accounting data can be useful in designing linear programming models. The degree of usefulness will be dependent upon the researcher's proficiency in linear programming techniques and his understanding of the nature of cost accounting data.

Simulation Models

Many cases exist in which one desires to study or evaluate the operation of a given system when changes are introduced into that system. One means of making such a study or evaluation would be to experiment with a "real-world" system. But the expense and difficulty of such an experiment eliminates it as a feasible solution to most problems. One alternative relied upon in recent years is the use of simulation models. These models are designed in order to represent the relevant characteristics of a "real-world" system. (15:131-132)

The advantages of simulating the operation of a firm should be obvious. Management can introduce changes into the firm via the model and note the results of the changes often at a fraction of the cost of "real-world" implementation. Since cost accounting data are from the "real-world", they certainly are useful in designing simulation models representing the firm. Again, the use of a hypothetical example will illustrate this point.

In this example let us assume that an educator desired to develop a management game[1] to aid him in teaching farm management principles. Since most management games are of "building block" design--activities are combined to make sub-systems, sub-systems into systems, systems into a business, and the business is combined with external factors (family goals, net worth position, etc.)--it is necessary to examine only one of the "blocks" in detail to note how cost accounting data was applied. One of the principles the educator wanted the game to demonstrate was the effect upon profit of a high value commodity with volatile prices and yields caused by varying one of the inputs. To accomplish this the educator had chosen the production of potatoes with fertilizer application as the varying input. To incorporate various levels of variability he decided that two activities would be used. In one activity both price and yield were permitted to fluctuate. Such a situation would exist if the farmer sold his potatoes on the open market. In the other activity only the yield was allowed to vary and price was assumed to be constant as in the case of a contract sale.

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[1] A management game is one type of simulation model that represents a firm. Players compete against each other to achieve maximum profit. In this case an analysis is made of the players rather than the firm itself.

The data requirements of these two potato activities are shown in Table 14. If Table 14 and Table 8 are compared, it can be observed how the educator extrated much of the needed information of the potato activities from cost accounting data. Some of the constant costs of the activities--fertilizer, spray material, seed and cover crops, truck, and others--were derived directly from the cost accounting potato enterprises summary. Also, the physical input-output coefficients required (e.g., labor, tractor) were obtained from supplemental physical data records. This was true for both those that were constant in relation to output and those that varied with output. To obtain the functional relationships of the latter, regression techniques were applied to the individual supplemental physical data records.

Also, the relative magnitude of the variation in yield from year to year can be obtained by comparing the yearly yield data of individual cost accounting farms.

Again as was the case with the linear programming model, not all the information needed was obtainable or best obtained from cost accounting data. The production function associated with fertilizer had to come from another source such as agronomy research. The contract price and average market price of potatoes and the price of fertilizer were obtained from other sources and the relationship between these can be changed as the game administrator sees fit. Finally, the standard deviation in open market potato price was obtained from other sources and can also be varied by the administrator.

The potato activities comprised only a small part of the entire management game. However, an examination of the data requirements of these activities does illustrate three major types of information--cost figures, physical input-output coefficients, and variability--which cost accounting data can supply in simulation models of the firm.

Table 14. HYPOTHETICAL DATA REQUIREMENTS FOR INTEGRATION OF POTATO ACTIVITIES INTO A MANAGEMENT GAME

Variable growing and harvesting costs per acre:

Land(1 acre)	C_1
Labor	
Early summer Type 1 (8 hours)	C_2
Early summer Type 2 (6 hours)	C_3
Early summer Type 3 (.8 hours)	C_4
Late summer Type 1 (7 hours)	C_5
Late summer Type 2 (6 hours)	C_6
Late summer Type 3 (X_1)	C_7
Tractor	
Early summer (36 plow-hours)	C_8
Late summer (X_2)	C_9
Equipment (1 acre unit)	C_{10}
Truck	3
Seed and Cover Crop	$61
Fertilizer (X_3)	C_{11}
Spray Material	$18
Other	$15

Returns:

Open Market Sale	$(Y_1) \cdot (P_1)$
Contract Sale	$(Y_1) \cdot (P_2)$

where

$Y_1 = Y_2 + V_1$ -- an equation for computing the yield with variation.

$Y_2 = 100 + X_3^{.71}$ -- production function (CWT per acre of potatoes related to application of fertilizer in pounds per acre)

C_1 = Cost of one acre of land as specified in the land system of the model.

C_2 = Cost of eight hours of early summer Type 1 labor (management level). The cost per hour is specified in the labor system of the model.

Table 14. (continued)

C_3 = Cost of six hours of early summer Type 2 labor semi-skilled. The cost per hour is specified in the labor system of the model.

C_4 = Cost of 0.8 hours of early summer Type 3 labor (unskilled). The cost per hour is specified in the labor system of the model.

C_5 = Cost of seven hours of late summer Type 1 labor. The cost per hour is specified in the labor system of the model.

C_6 = Cost of six hours of late summer Type 2 labor. The cost per hour is specified in the labor system of the model.

C_7 = Cost of X_1 hours of late summer Type 3 labor. The cost per hour is specified in the labor system of the model.

C_8 = Variable cost of 36 early summer plow-hours of tractor usage. The cost per plow-hour is determined in the tractor system of the model.

C_9 = Variable cost of X_2 late summer plow-hours of tractor usage. The cost per plow-hour is determined in the tractor system of the model.

C_{10} = Variable cost of potato equipment. Cost is dependent upon number of acres and yield level (Y_2) and is determined in the equipment system of the model.

$C_{11} = P_3 \cdot X_3$ -- equation for computing the cost of fertilizer.

$X_1 = .13Y_1^{1.1}$ -- equation for computing the number of hours of late summer Type 3 labor needed.

$X_2 = .07Y_1^{0.9}$ -- equation for computing the needed number of tractor late summer plow-hours.

X_3 = Pounds of 10-20-20 fertilizer applied per acre.

$P_1 = P_4 - V_2$ -- equation for computing the open market price (dollars per CWT)

P_2 = Contract price (dollars per CWT) of potatoes.

P_3 = Price (dollar per pound) of 10-20-20 fertilizer.

P_4 = Average open market price (dollars per CWT) of potatoes.

V_1 = The variation in yield. A normal standard deviation is drawn from a normal distribution with a standard deviation of 125 CWT per acre with a mean of zero.

V_2 = The variation in open market price. A normal standard deviate is drawn from a normal distribution with a standard deviation of $1.15 per CWT with a mean of zero.

Partial Enterprise Accounting

In conducting the survey[1] on farmers' attitudes regarding records many farmers expressed an interest in having detailed costings on selected enterprises of their farms. However, they did not desire to keep complete cost accounting records. The development of partial enterprise accounting could satisfy the wants of these farmers.

Since partial enterprise accounting is an incomplete accounting system, information must be obtained from other sources. Cost accounting records can be particularly valuable in developing a partial enterprise system. Since data must come from outside the system, there is a chance that this data may not be accurate. Therefore, to evaluate the degree of correctness a standard of comparison must be established. Cost account costings can serve as this standard. Also, cost accounting data can be used as the supplemental data source needed by the partial enterprising system.

In Table 15 the costs of Table 11 have been regrouped into two separate categories--direct and external costs. The direct costs are easily allocated in a partial enterprise system to the heifers. The external costs, because they are not directly recorded costs, are estimated by special methods. The method used will depend upon the degree of error allowable.[2] For example, one simple method would be to use only cost account averages for these costs. This, of course, assumes that the variation in the costs among farms on these items is small. However, an examination of the individual cost account records (e.g., labor, building and equipment) may indicate that a more complex method may be desirable to improve upon the accuracy of these costs. For example, the amount of labor per heifer applied may vary greatly from farm to farm. Therefore, it may be desirable to have the farmer keep additional records on the number of hours of labor applied to his heifer enterprise. Multiplication of the number of hours by a standard rate per hour may improve the level of accuracy to an acceptable level. Likewise, methods must be developed for approximating the other external costs. Cost accounting data can be useful in supplying rates (e.g., cost per hour of operation of a tractor) and developing costing formula.

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[1] Survey was discussed in detail in Chapter 1.

[2] When studying the error in costings, it must be done on individual farms rather than on a group of farms. This is because errors associated with each farm may be quite large, but if one farm's error offsets another, the average error for the group would be small.

Table 15. HEIFER PARTIAL ENTERPRISING
DIRECT AND EXTERNAL COST AND RETURNS

Debits			
Partial enterprising direct costs:			
Variable		$45,668	
Beginning inventory	$26,000		
Calves 42 started	1,638		
Milk and milk substitutes	1,368		
Grain	3,808		
Hay 184 tons	4,795		
Silage (Hay) 8 tons	115		
Silage (Corn) 320 tons	3,144		
Pasture	1,625		
Bedding	395		
Breeding fees	295		
Veterinarian and medicine	15		
Registrations and transfers	105		
Interest	1,560		
Other	805		
Total partial enterprising direct costs			$45,668
Partial enterprising external costs:			
Fixed		1,875	
Equipment	245		
Tractor and truck	55		
Buildings	1,575		
Variable		4,555	
Equipment	85		
Tractor and truck	65		
Buildings	345		
Labor 208 hours	3,650		
Insurance	95		
Utilities	315		
Total partial enterprising external costs			6,430
Total Debits			$52,098
Credits:			
Ending inventory			26,000
Heifers sold			25,580
Manure			240
Other			30
Loss			248
Total Credits			$52,098

CHAPTER X

SUMMARY AND CONCLUSIONS

In designing the computerized cost accounting system, it was assumed that the records should aid farmers in their goal of profit maximization. Although it is desirable to have the records provide marginal cost and revenue data, it is not possible to obtain such data from accounting records. As an alternative, the cost accounting system can provide management with average cost and returns information on the enterprises or activities of the business. Furthermore, these average costs can be divided between fixed and variable to help in making business decisions.

In the system three different records are used to record the necessary information. All are designed to be summarized with the aid of a computer. Two of these, the inventory and supplemental physical data record, should be summarized in a manner such that they supply the necessary data for the summary and analysis of the financial records.

The financial accounts are divided into four main groups: overhead, allocation, production and miscellaneous accounts. These are used for direct cash expenditures and intra-firm transfers. Whenever possible, it is desirable to use market values in making intra-firm transfers. The accounts for which this can be done are the land and dwelling accounts. When market values are not available, then the intra-farm transfers should be priced at cost. In some of the accounts, (labor and improvement accounts) the transfers may be assumed to be only variable costs. In the equipment and building account, the costs should be divided between fixed and variable and the transfer pricing should reflect this division.

Allocation accounts are convenience accounts used to accumulate costs. These costs, at the end of the accounting period, should be passed on to the enterprises for which the costs were incurred. The method used to allocate the costs will depend upon the allocation account.

Production accounts are divided between livestock and crops. These are the heart of the farm business and a large number of costs, returns and analysis factors can be derived. The costs associated with these accounts should be categorized as to fixed and variable for management purposes.

The costs of the crops should be divided and sub-divided. First, the costs for the crop enterprises should be divided between production and storing and selling and each should be subjected to a profit and loss analysis. Second, the crops production sector should be sub-divided between growing and harvesting.

Provisions have been made for only three livestock accounts to be analyzed in detail--dairy cows, dairy heifers and laying hens. The method of analysis used in each case should be adapted to the individual account.

Miscellaneous accounts serve only for the completion of the accounting system.

One of the primary purposes for using electronic data processing equipment to summarize the cost accounting records is that the data can be more easily adapted to the researcher or educator's need. Cost accounting data can be used in many of the newer management tools. The limitations in its use in research problems is related to the nature of the data and the ability of the researcher to adapt the data to his problems.

The new computerized farm cost system can supply the farmer with more decision-making information than he had previously. Also, the researcher and educator should find the system more flexible in satisfying their data needs.

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APPENDIX

Introduction

The second objective of this project was to make changes in the methods of handling the records so that the computer could be used as an aid to summarization and analysis. Also, by using the computer in the analysis and summarization of the records the cost accounting data would be more readily available for manipulation by researchers and educators for use in their endeavors.

The purpose of this section is to describe the programs and computer facilities used in the analysis and summarization of the cost accounting records.

All the programs except the sort programs were written in Fortran IV-DOS language for execution on an IBM 360 system-Model 40 computer with 128K core capacity, disk and tape input-output units, card reader and printer. Input and output of data on tapes and disks was performed by specially written Assembly language subroutines.[1] These subroutines increase the speed of data handling over the facilities associated with the Fortran language.

All the sorts are made using IBM's tape operating sort program. In utilizing this program only a few control cards are needed to accomplish the desired sorting of the data. In all the sort programs the record size and blocking of the records of the output tape remain the same as the input tape.

The programs can be classified into three groups: supplemental physical data (LAB) programs, inventory (INV) programs, and financial (FIN) programs. The classification corresponds to the three types of records used in the cost accounting program.

The description of the programs which follows is the narrative and block diagram form. The actual listing of the programs, which in total has in excess of ten thousand Fortran statements, has not been included. Anyone desiring more detail concerning the programs should request a listing of the latest refind and modified programs from the Department of Agricultural Economics, Cornell University.

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[1] These subroutines--RWFAT and D7A for tape and DIRAC for disk--were written by members of the Department of Animal Science of Cornell University and are part of the Dairy Records Processing Laboratory Systems pack.

Supplemental Physical Data Programs

The Supplemental Physical Data Programs are designed to store the supplemental physical data records submitted by the cooperating farmers on computer tape and make analysis of them. The block diagram for the five supplemental physical data programs is shown in Figure 4.

Program LAB-100

LAB-100 is a card-to-tape program with some edit and computational functions. It is designed to transfer the data from the supplemental physical data cards to tape while editing for errors in the cards. The giving of assigned enterprise codes is done by the program before the records are written on the output tape (TP100).[1]

Because of the edit function of the program there will be some cases in which the program will reject certain cards because of errors and not transfer the card information to tape. In such cases the cards can be corrected and pooled with other cards which correct for farmer and clerical errors. At a later date these cards can be added, via this program, to the correct information already stored on tape TP100 (old). The printout of the program indicates which cards have been rejected. The printout also includes additional messages indicating possible trouble conditions such as enterprises needing special assignment codes. These should be punched and added to the original enterprise assignment cards because these cards will be used in later programs.

Program LAB-105

LAB-105 is a sort program designed to take data from the input tape TP100 and arrange it in the order necessary for execution of program LAB-100. The output tape of this program is TP105.

Program LAB-110

The purpose of program LAB-110 is to summarize the physical input-output relationships by sub-field, field, operation, enterprise and the entire farm. The individual supplemental physical data entries are listed in chronological

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[1] All the programs are programmed not to key on the actual enterprise code used by the farmer but on an assigned enterprise code. The assigned enterprise code is used to indicate the type of enterprise to which the record relates. In most cases the assigned and actual enterprise codes will be the same. However, there are cases in which they will be different. These cases originate when a farmer has two of the same type enterprises (e.g., apples) but there is only one actual enterprise code available. To allow for the situation one enterprise is given the actual enterprise code available for that type enterprise and the other enterprise is given a non-defined actual enterprise code. In order for the computer to treat both enterprises in the same manner both are given assigned enterprise codes equal to the actual enterprise code available.

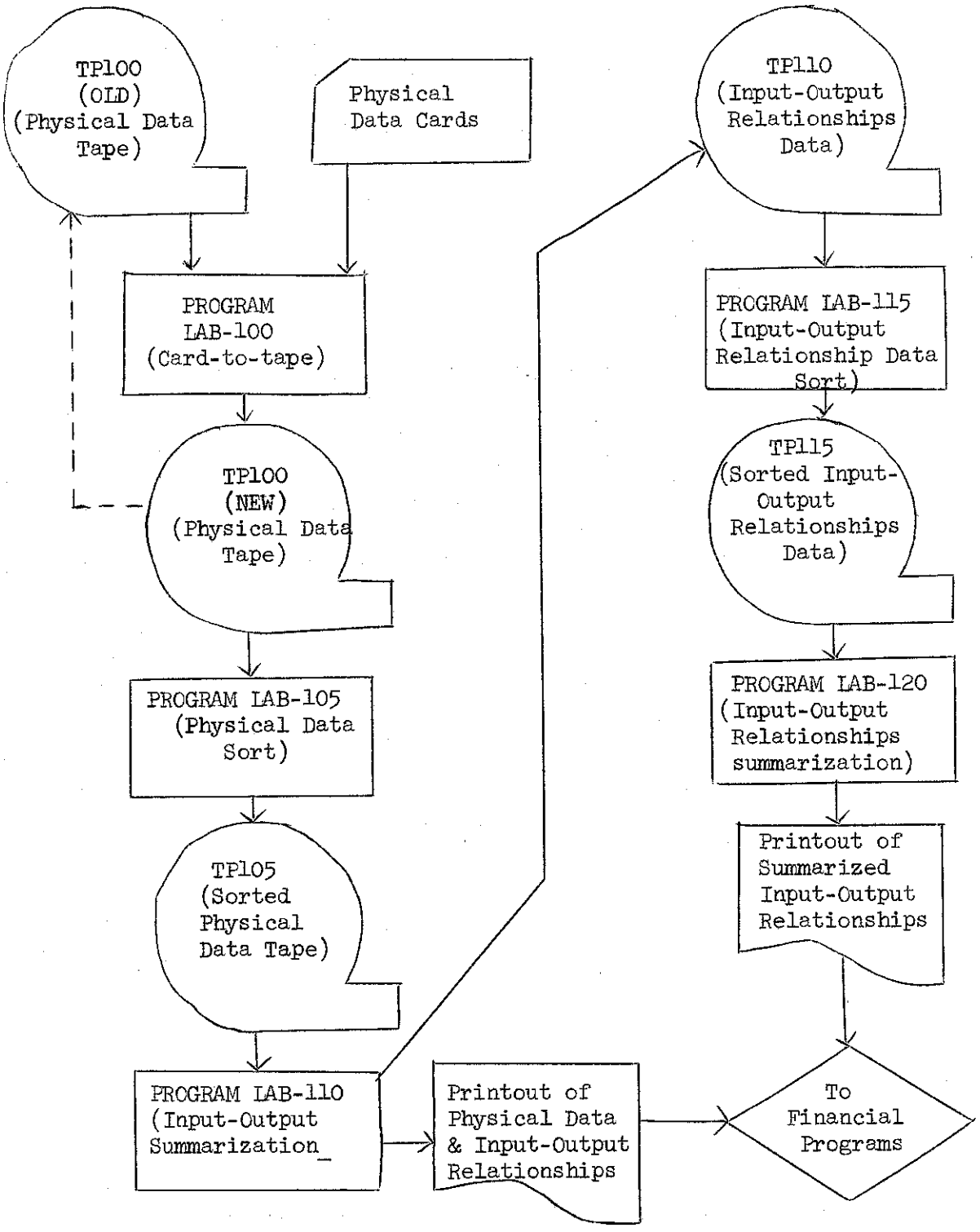

Figure 4

Block Diagram of Supplemental Physical Data Programs

order. Whenever an entry has certain codes that differ from the proceeding code, then totals are printed and accumulated. The codes which the program is designed to monitor for change and the order of accumulation, (largest number is the highest level of accumulation), are listed below:

Code	Accumulation Order
Sub-field	1
Field	2
Operation	3
Enterprise	4
Entire Farm	5

For many enterprises only the totals at the enterprise level are essential for the closing of the cost accounting records and any printing of totals at a lower level only increases the cost of executing the program. Likewise, there are enterprises (e.g., crops) that require operation totals but do not require field and sub-field totals and the printing of these totals also increases cost. In such cases the program is designed to eliminate unnecessary printing of totals. However, there may be cases (e.g., special research problems and at the farmer's request) that all totals are needed. The program is designed to accommodate such needs through the program control cards.

The program is used at two different stages of closing. The first is when closing information is gathered from the farmer. This information can be used to point out errors or omissions in his reporting of the supplemental physical data. Also, if the magnitude of the errors or omissions is small, then the summary data can be used to aid the farmer in establishing his charge-out ratios.

The program is executed a second time after all corrections have been made in the supplemental physical data by program LAB-100. The summary information of this program and program LAB-120 is used by the office personnel in making the closing entries of the cost accounting books.[1]

The output tape (TP110) of this program contains the summary information that is printed by this program. This summary information is specially sorted and later used in programs LAB-120.

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[1]At present the programs do not automatically make closing entries based on the summary data from the supplemental physical data records. However, as the programs are modified and refined, prime consideration should be given to developing a program that would take the summary information stored on tape TP115 and combine it with financial data taken from the printout of program FIN-325 to produce the financial cards to be submitted in program FIN-330.

Program LAB-115

Program LAB-115 sorts the output data from program LAB-110 so that it is in acceptable form for execution of program LAB-120.

Program LAB-120

Program LAB-120 is similar to program LAB-110 in that it also relates to summarization of the supplemental physical data records. The function of program LAB-110 is to summarize input-output relationships of the farm, enterprises, operations, fields, and sub-fields. This program indicates for all the inputs (e.g., all the different types of labor) which enterprises, operations, etc., made use of the input and the quantity used. The same is done for all the outputs (.e.g, yield of crops). The program also has provisions for proportionally adjusting the recorded usage of equipment by enterprises, operations, etc., such that the total of the recorded usage is equal to that of the actual usage. This is done by using program control cards for those farms that have equipment usage figures that need adjustment.

Inventory Programs

The Inventory Programs are used to store and analyze the beginning and ending inventories of the cost account farms. Five inventory programs (Figure 5) are involved in keeping the records up-to-date and in supplying the farmer with inventory information.

Program INV-200

The main function of program INV-200 is to add the beginning inventories of new cost account farmers to the existing inventory tape file (TP220) and to eliminate unwanted farm inventories from the file. The beginning inventory items of the new cost account farms are punched on cards. The cards are read and edited for errors in coding. If the information on the cards is found to be correct, it is then added to the existing inventory file to form a new inventory tape file (TP200). If the card information is incorrect, then a message is printed to indicate the errors. The errors are corrected and the program is run a second time. The unwanted farm inventories are dropped from the inventory file by not being transferred to the new inventory file (TP200). Control cards of the program accomplish this function. It is important that all the farms' inventory data be included correctly on TP200 before proceeding with the other inventory programs.

The second function of this program is to give the inventory items enterprise assignment codes. These assignments are made on both the existing inventory items and the new items that are being added.

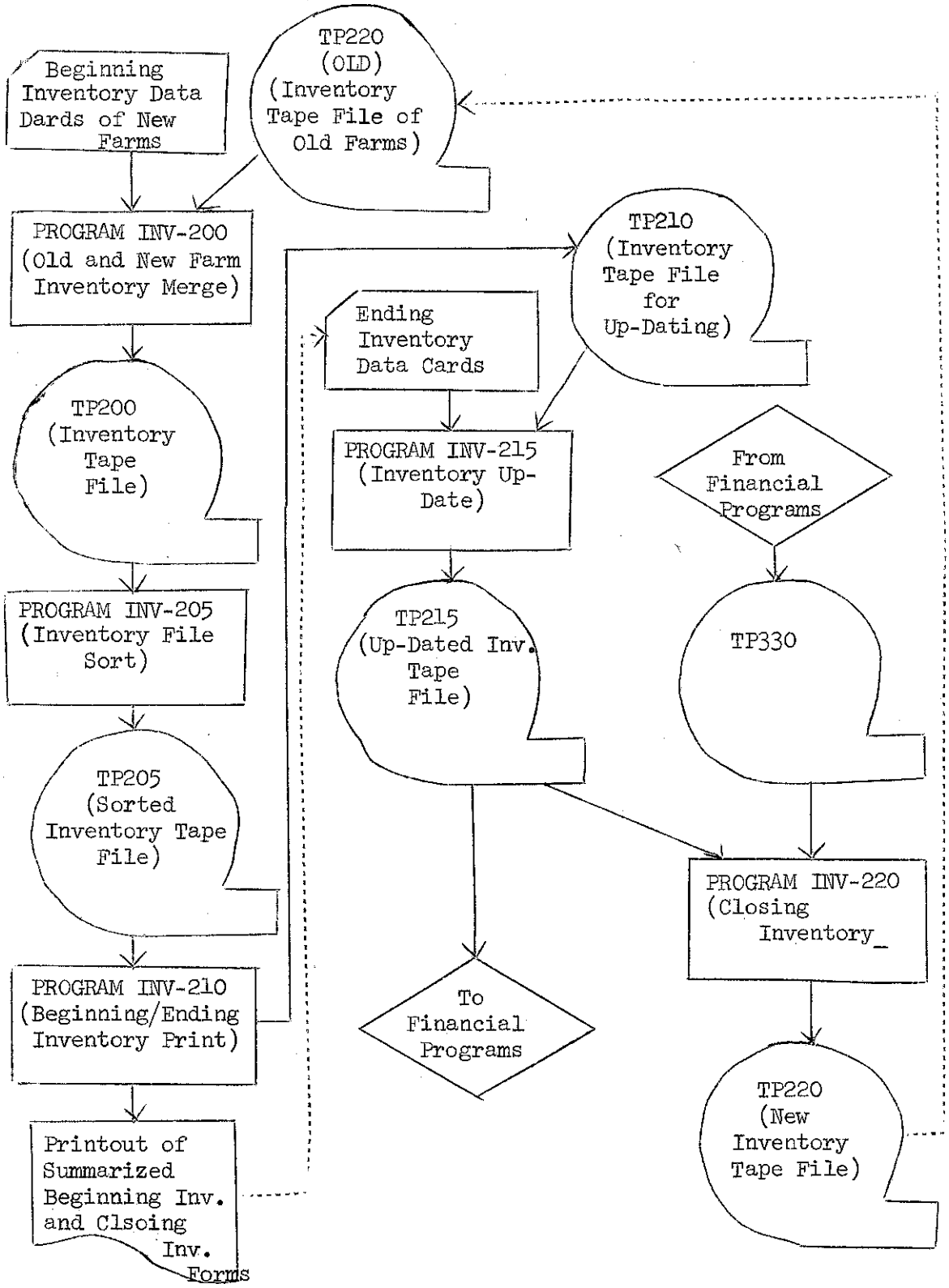

Figure 5. Block Diagram of Inventory Programs

Program INV-205

INV-205 is a sort program that arranges the data from inventory file TP200 onto output tape TP205 so that the inventory data can be used in the execution of program INV-210.

Program INV-210

The main function of program INV-210 is to prepare the closing inventory forms. However, this program serves a second and very useful function of checking the accuracy of the new inventory data added in program INV-200. One of the main inaccuracies to look for in these new inventories is a non-balancing inventory. These new farm inventories can be examined by themselves by indicating such on the program cards. If any of the new inventories are found to be in error, then it is necessary to revert back to program INV-200. Program INV-200 is rerun with the corrections made in the new inventories and a new inventory tape file (TP200) is made.

However, if the new inventories are found to be correct then the program is rerun in order to obtain printouts of all the farms' beginning inventories. The inventories are then sent to the farmer to enable him to assign ending inventory quantity and dollar values. These values are placed directly on the printout sheet in the spaces provided. To aid the farmer in this task he is given the past five inventory dollar values, the beginning inventory quantity, and the age of the item.

If the farmer has new items to be added to the inventory because of acquisitions during the year, he can easily do so on the special forms printed by the computer at the end of the inventory pages.

At the end of the listing of the inventory items there is a concise easy to read summary of the beginning inventory items.

The output tape (TP201) of this program is used by the next program, INV-215. This tape is essentially the same as tape TP205 except that those inventory items that were not included in the ending inventory of last year (beginning inventory of this year) but were on the beginning inventory of last year are eliminated from the inventory tape file.

The completed inventories are collected by the field representative when he gathers the closing information from the farmer. If there are any problems or questions regarding the inventory, they would be resolved by the field representative.

Program INV-215

Program INV-215 is used to produce a new inventory tape file (TP215) with all the items in the beginning inventory given either an ending dollar and quantity value or a code indicating that this item has been disposed of during the year. For most inventory items this is done by cards. The values on the cards are keyed to the inventory items on the tape file (TP210) by the farm number and the inventory number assigned to each item. However, there are

inventory items that have their year-end dollar and quantity value computed automatically. Examples of this are the lime inventory items and the trial balance net worth of each farm. The program also adds to the inventory tape file new inventory items.

This program also monitors the data for errors. It checks for possible special enterprise assignments that may be needed but have been overlooked. This type of error is not serious because it can be corrected later and the program only prints a message indicating that a special enterprise assignment code may be needed. However, the program also searches for more serious types of errors. If the program finds an error in coding or an inventory item that was not given ending inventory values or a disposal code the program indicates these errors and an output tape (TP215) is not formed. The error should then be corrected and the program executed again.

Program INV-220

Program INV-220 is used to pick up the inventory items on financial tape TP330 (new) that are not on the inventory tape file TP215. These inventory items are the "inventory type" financial transactions (e.g., non-bearing orchards) that are made in closing the financial books. The program scans the financial tape for these types of transactions and upon finding one adds it to the latest inventory tape file (TP215) to form a new inventory tape file (TP220). Inventory tape file TP220 is the ending inventory tape file and becomes the starting tape for developing a beginning inventory tape for the new year's accounts.

Financial Programs

The financial programs make use of data from both the supplemental physical data and inventory programs and, therefore, are the last to be discussed. These programs require the greatest amount of human effort of the three groups of programs. A substantial amount of human logic and computation is involved in addition to that performed by the financial programs (Figure 6) to accomplish the closing of the books. Because of this these programs offer the greatest payoff for program refinement efforts.

Program FIN-300

Program FIN-300 is the initial program in the analysis of the financial records. It has three main functions. The first function is to scan the tape of the Farm Business Management Electronic Accounting Program for data of cost accounting farms. When cost account farm data is located, it is transferred to the output tape (TP300). The second function of the program is to add, via cards, financial data of late reporting farmers to that already stored on tape. The final function of the program is to assign enterprise codes to both tape and card financial entries.

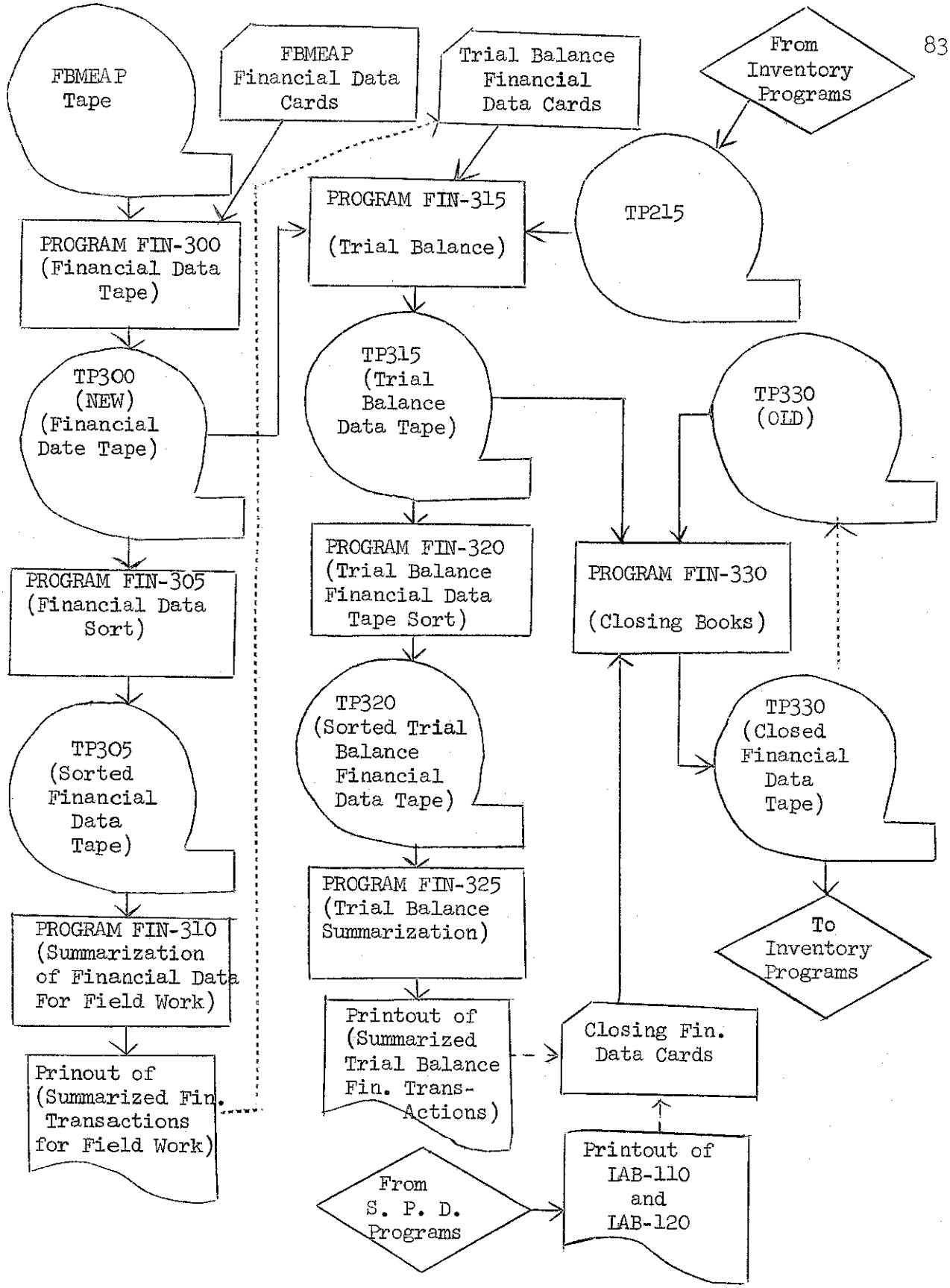

Figure 6. Block Diagram of Financial Programs

Program FIN-305

FIN-305 is a sort program that has as its function the arranging of output data from program FIN-300 for the proper execution of program FIN-310.

Program FIN-310

Program FIN-310 is used to print the financial information that the farmer has mailed in during the year in a manner that is easily used for gathering closing information from the farmer. Each type of enterprise (e.g., equipment, livestock, crops, real estate, etc.) has standard groupings of cash expenses and receipts. The program prints out the appropriate title for each grouping, the entries the farmer has recorded during the year under the title, and totals the quantity and dollar amounts of the entries under each grouping. With the financial information summarized in this fashion, the field representative can easily note entries that the farmer may have neglected to report or for which intra-farm transaction entries are necessary. The field representative can write on the printout the closing information given by the farmer. These printouts are subsequently used by the office personnel in making the trial balance transactions.

Program FIN-315

After gathering closing information from the farmer, the first step in closing is to take a trial balance. Program FIN-315 and programs FIN-320 and FIN-325 are used in obtaining a trial balance and a printed summary of the financial records.

The program has six man functions. The first function is to add financial transactions by card input to those that exist on tape TP300. These additions are to correct for faulty data caused by either recording errors or omissions of the farmer or clerical errors in the office.

Before taking a trial balance it is usually the practice to make numerous intra-farm transactions. The second function of this program is to allow for the making of intra-farm transactions. These transactions are made by using the same cards that are used to make corrections in the data.

In making a trial balance the sum of debits and credits of all the accounts have to balance. To achieve a balancing, balancing entries have to be made to the cash account. Likewise, data added in this program that affects the ending inventory will also affect the net worth and a balancing net worth entry is therefore needed. As a third function this program computes both the cash and net worth balancing entries. This feature of the program saves time in making intra-farm transactions.

The transformation of the data from the inventory file (TP215) into financial data is the fourth function. The assets and liabilities of the beginning inventory are made into debit and credit financial transactions respectively. For the assets and liabilities of the ending inventory the program does just the opposite.

The added data and intra-farm transfers are subject to errors. As a fifth function the program monitors the data for errors. If an error transaction is found the program writes out the error transaction and indicates it as such. The error transactions are not transferred to the output tape (TP315) and will have to be corrected and added to the correct financial information in program FIN-320.

The final function of this program is to give the entries enterprise assignment codes. This is a necessity for the added data and the intra-farm transfers; but it is also done for all of the original financial transactions taken from tape TP300 and the inventory data taken from Tape TP215. In giving new enterprise assignment codes to all the financial transactions written on the output tape (TP315) it is possible to correct for wrong enterprise assignment codes given in earlier programs.

Program FIN-320

Sort program FIN-320 is identical in design to that of program FIN-305. The only difference between the two is that they have different input and output tapes.

Program FIN-325

Program FIN-325 has a function which is similar to that of program FIN-310. Where as program FIN-310 is concerned with printing out the financial data of the farms in a format that allows for gathering closing data from the farmers, this program is concerned with printing out the trial balance financial data in a manner that expedites making of final closing intra-farm transactions.

The program prints the titles of costs and returns groupings of the enterprises. The titles are nearly identical to the cost and returns illustrated for the different enterprises in the main text. The trial balance entries are listed under the appropriate title and summary totals are given for each grouping. For some of the titles there will be no financial entries because under these titles the final intra-farm closing entries are yet to be written. The written entires are transferred to cards and submitted in the final financial program FIN-330.

Program FIN-330

Program FIN-330 is used to add the closing intra-farm transactions of a farm to the same farm's existing financial transactions stored on Tape TP315. In this process the program checks all enterprises and the ending inventory to note that they balance. If all the enterprises and the inventory of a

farm balance, which in turn means that the books are closed, the entries of the farm are added to the entries (TP330 (old)) of other farms with closed books and stored on tape TP330 (new).

However, if an enterprise and/or the inventory of a farm does not balance then that farm's financial data is not written on the output tape. After the errors which caused the enterprise and/or the inventory not to balance are located and corrected, closing cards of the farm are again submitted. This process is continued until all farms have their books closed and, therefore, their financial data stored on tape TP330 (new).

The program again gives enterprise assignment codes to all the entries written on the output tape. Giving of enterprise assignment codes to the intra-farm closing transactions is a necessity. However, it is also done on all the other entries in order to allow for a final chance in changing of these codes. The probability of change at this point in the program is small but the provision is there if the need arises.